ADP

Which computer ? *—choosing the right one*

New products and systems—exclusive US report

Harris Lebus keep ahead of the market

What they said in Glasgow

FULL LIST OF CONTENTS ON PAGE 1

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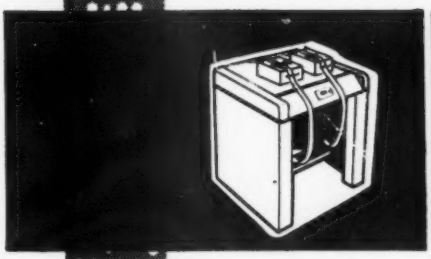

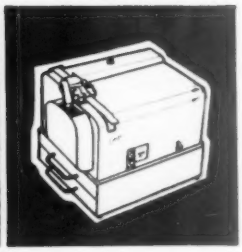

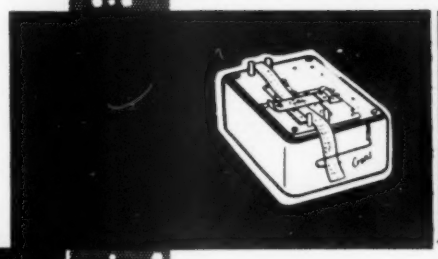

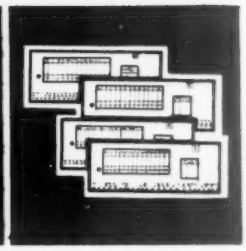

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For instant, accurate, two-way office-to-office communication of business data—over any distance, between any number of locations. A single, initial transmission delivers data at destination(s) in printed page form, on multi-copy stationery or as punched tape for subsequent automatic processing.

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AUTOMATIC DATA PROCESSING

VOL 2 No 5 CONTENTS MAY 1960

JOURNAL OF MANAGEMENT AND INFORMATION SYSTEMS

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AUTOMATIC DATA PROCESSING

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Keeping up the Momentum

THE early business computer era produced an astonishing child: salesmen who began by thinking electronic computers were merely a grander breed of accounting machine changed their minds quickly—the equipment was too expensive, had too many capabilities, to be sold as little *ad hoc* solutions to the accountant's numerous, but never related, problems. Quick to realise they were to sell universal office machines, the salesmen discovered the 'total systems concept.'

For this we should be grateful. Computer studies—whether they are called appraisals, feasibility studies or justification studies—show time and again that merely to *look* into all the nooks and crannies of a company is almost as good as a spring cleaning. Certainly, a few organisation and methods men investigated widely, when they were allowed to, before computers were heard of, but never on the scale on which investigations are made today. The old O & M school might not, anyway, have been capable of the thorough work presently being done. There is a shortage of qualified men—systems analysts, consultants, what you will—second only to the shortage of scientists and technologists, as even a casual glance at the appointments and situations columns of the newspapers show.

At the root of this is a lack of training opportunities; computer manufacturers, because their bread and butter is involved, provide a grounding and a methodology in systems work. So do a limited number of companies. The rest are still not convinced that it is as important to invest in good systems as it is imperative for certain industries to sink money in scientific research and development, and consequently contribute to the sad fact that annually Britain's productivity increases at a much lower rate than our neighbours'.

It would be a pity if the impetus that the existence of computers (and, of course, their salesmen) has given to a movement for complete and critical examination of company organisations was lost. Unfortunately, as John Diebold points out in these pages, this may well happen now that smaller and cheaper machines are being hastily assembled—the temptation to buy a computer to do one task or even just so that the gadgeteer in the company can 'gain experience' will appear, and the opportunities to improve and *save money* will be missed.

The opportunities certainly exist: there are too many thriving professional consultancy firms (who charge 150 guineas a week for the work of a consultant who may stay three to six months with a client company, and yet still reckon to save their clients thousands of pounds) to doubt this.

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in data processing

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The equipment produced by De La Rue Bull Machines Ltd., its manifold applications and the methods by which it is applied . . . open discussion by international personalities, of the problems and projects connected with the current computer world . . . these are just some of the interesting contents of the News Report by De La Rue Bull Machines Ltd. Make sure that you are on the mailing list. Return the coupon without delay.

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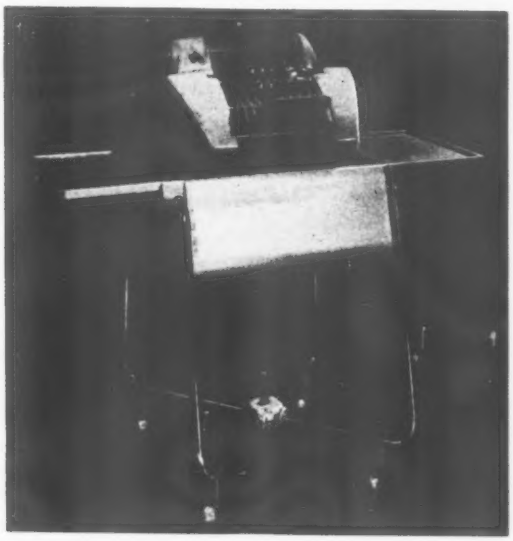

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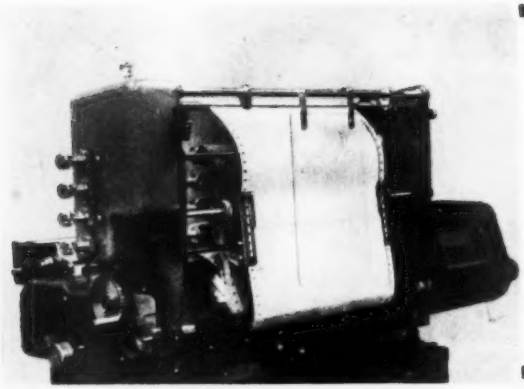

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The Fanfold technicians have now produced a new lightweight Carbaline Feed for the I B M Accounting machine. This Feed has three features which make it exceptionally easy to use :

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As with previous Carbaline Feeds the carbon paper is supplied from rolls which creep a fraction of an inch for each printing cycle of the Tabulator, thus ensuring the maximum economy in the use of carbon paper. The use of one-time carbon and its subsequent removal is eliminated and up to five-part sets can be produced. Where more than five copies are required a special Hectographic feed is available.

* *Similar feeds are available for I.C.T. Hollerith and Powers Tabulators.*

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this is the Novano System

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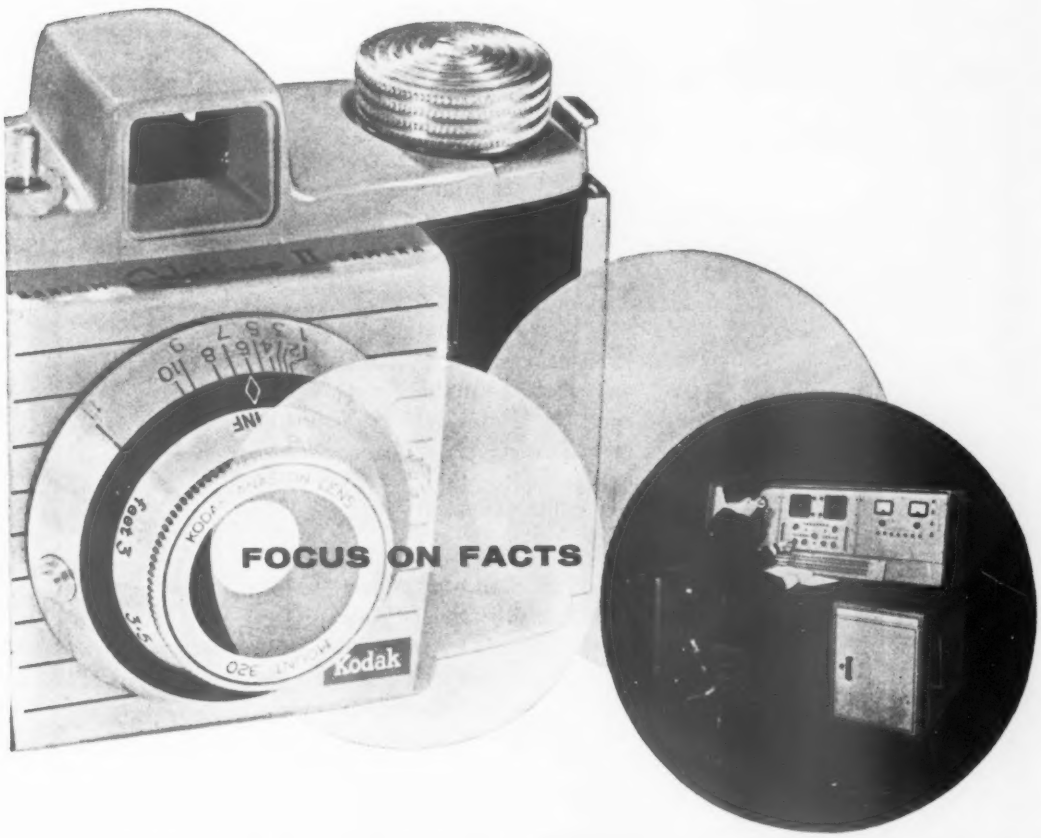
Flexibility in operation, ease in storage, and economy are three advantages of the Novano system, now adopted by many well-known firms with extensive tabulating machine installations.

An examination of the Novano system may suggest its economic employment in the interests of added efficiency in your installation. Enquiries will be welcomed by the sole U.K. concessionaires and consultants:

Punched Card Accessories Ltd., Abbey House, Victoria Street, Westminster, London, S.W.1.
Telephone: ABBey 2691-3

Novano is a product of Novotechnics Ltd., of Letchworth, Hertfordshire.

Photograph by courtesy of 'BP'



KODAK CHOOSE EMIDEC

Everyone knows Kodak, and the wide range of photographic goods they produce. It is not difficult to imagine the problem involved in maintaining an efficient production and distribution organisation.

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Designed and manufactured by E.M.I. Electronics Ltd., the EMIDEC 1100 is a high speed computer, using transistor and magnetic core techniques.

Kodak will use the computer to maintain up-to-date records of stocks held at its nine wholesale branches throughout Great Britain. The EMIDEC will also print out invoices and maintain personal accounts and statistics for each of the organisation's 30,000 customers and trade outlets.

EMIDEC computers have been selected by many other large organisations and Government departments including:

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Marylebone Road · London NW1

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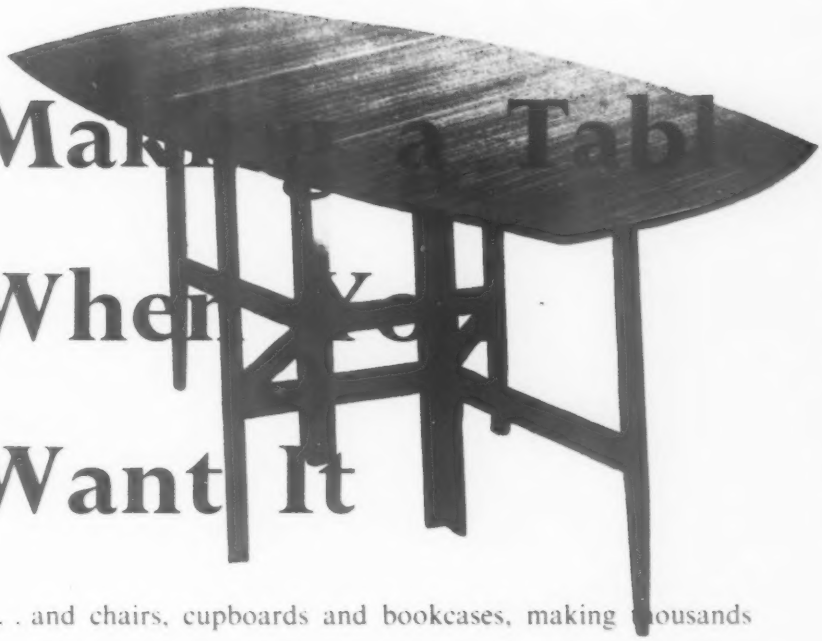


. . . . and chairs, cupboards and bookcases, making thousands in a year, means having the wood, the men and the machines when you want them—it means a well-organised information system to relate sales forecasts to production.

THE largest single furniture-manufacturing unit in the world stands on 43 acres astride Ferry Lane, in Tottenham, North London. This is the main factory of Harris Lebus Ltd, makers of domestic furniture, where a total of 3,500 production workers and administrative staff are employed.

The company also has an upholstery factory at Woodley, Reading, and a number of subsidiary companies at Tottenham. One of these is a road haulage company which delivers the company's own products and carries return loads under contract to other firms; another a finance company, financing hire purchase agreements for Harris Lebus Ltd and other companies. In addition to the subsidiary transport company, Harris Lebus have their own fleet of 150 lorries.

The firm was founded a little over a century ago and makes a wide range of furniture of varying designs, both traditional and contemporary.

Most of the timber used in the Tottenham factory is imported from Nigeria; and because the seasonal fluctuations of the rivers in Nigeria affect the shipping of the Obeche and Abura wood, it is important to the company's buyers to have reliable forecasts of the factory's needs. This is one of the typical problems reflected in the system of data processing by which the company's sales statistics and production planning are related: another is the rather surprising seasonal fluctuation of the demand for domestic furniture in the British market, but it is a familiar phenomenon to everyone engaged in the furniture trade.

Although the directors of the company first considered the purchase of a computer in 1955, the present system makes use of Adrema machines, National multi-register machines and a battery of punched card machines and ancillary equipment for summarising data and statistical analysis; but the ground has been laid for the

'The largest furniture factory in the world' — a view of Harris Lebus' plant in Tottenham

introduction of more advanced electronic equipment and the present system is advancing towards a degree of integration sufficient to make possible a smooth transfer.

Sales statistics are tabulated on 40-column Powers-Samas punched cards. There are four tabulators, two of which include summary-punch attachments, three sorters, 14 automatic key punches and an automatic verifier.

There is also a battery of three Powers-Samas 21-column card tabulators in association with two sorters, two reproducers, two interpreters and two automatic key punches. This assembly is used for factory wages and for despatch statistics.

The factory at Tottenham is organised in three zones. Zone one is concerned with machining and 'primary parts,' zone two assembling, and zone three staining, polishing and fitting. A 21-column card is produced for each operation that each article goes through in zones two and three. The cards are attached to the articles of furniture and, as each operation is completed, the operator extracts his card, which records, in numerical code, the design, operation and time allowed for the job. At the end of each day the cards are handed to the foreman, who arranges them in a tray in order of operators' clock numbers. The appropriate clock number is then punched into each of the cards, which are then passed through the summarising tabulator which summarises the total hours earned daily by each operator. This summary is exhibited in each shop in zones two and three on the following morning, so that any queries can be checked at the office.

The 21-column cards are also used for daily despatch statistics. When a lorry leaves with a load, the ledger-posting copies of the invoice are sent to the 'Powers room,' where a 21-column card is plucked for each design despatched. This information provides the basis of a control on the sales ledger.

At the end of each week a 40-column card is punched for each man in the factory. The 21-column tabulations are the source documents for zones two and three; for zone one, detailed bonus cards are prepared from manual documents and from these bonus cards similar tabulations are prepared. The bonus cards show the cost code against which each job is charged, the time taken on the job, the man's clock number and his rate. From this summary the men's wages are calculated on Comptomers and Friden calculators.

The 40-column cards are also used for the analysis of expenses, divided into direct and indirect expenses. Under the first head are men's time and materials; indirect expenses include such factors as repairs, sweeping and machine breakdown. An analysis of the purchases ledger is also made on 40-column cards from which purchases of materials are charged out to each department to be set against the departmental budget. In addition, many materials are charged as direct production costs.

THE ANNUAL CYCLE

The foregoing account is a brief summary of the system at present in use. The Organisation and Methods department have been working on a feasibility study for an integrated routine since February, 1959, though some preliminary and exploratory work had been done before that date. The account that follows is necessarily somewhat superficial as a detailed description would obviously extend to quite impracticable proportions. It does, however, attempt to state the various phases of the present system in logical sequence.

In November of each year a sales forecast is

prepared for the first six months, January to June, of the following year. Also, the year is divided into thirteen four-week periods, and a forecast is prepared of the sales expected of each 'line'—*ie*, of articles of furniture of each of the various designs—in each of these four-week periods. This forecast is broken down into man-hours of labour and quantities of material. The materials forecast is for timber and does not take into account metal parts which are bought out and for which the deliver dates are normally short.

The timber forecast is, of course, of primary importance as it has to take into account not only the availability of the timber but also shipping space. Ideally, this forecast should look with fair accuracy six months ahead of production needs in the factory.

Production planning, of course, can only be based on a sales forecast which itself depends upon a reliable sales analysis and the appreciation of past sales in relation to past and current trends, salted with intelligence and intuition in assessing future trends.

The sales analysis comes from orders received into the factory. These have various sources. There are 50 or 60 representatives, or travellers, in four major areas in the United Kingdom. (The proportion of export trade is small and will not be taken into consideration in this account.) There are also showrooms in many of the larger towns, and orders come from mail order houses and from individual customers.

The travellers' orders come in on standard printed forms, but from the other sources they may arrive in any one of hundreds of forms, including the backs of old envelopes. *Between 800 and 1,000 documents are received each day.*

ORDER HANDLING

When the orders are received at the Tottenham factory they are first 'vetted' to ensure that the designs ordered are available. They are then sorted geographically, in alphabetic sequence of towns.

Adrema address plates are maintained for about 9,000 customers. At present a system of pre-billing is operated on Adrema machines. Sets of Adrema plates contain details of design, price, purchase tax, cubic capacity of articles of each design, a product group code and a code which forms the basis for paying the loader when the goods are despatched. There is a plate for

'Throughout the planning phase the aim has been to evolve a fully integrated system that will eliminate the waste of time and duplication of work that may occur when data processing is passed between discrete office departments'

each unit quantity and an address plate for each customer. A numerical code is used.

Each customer's address plate contains the customer's code number, a Board of Trade area number, the traveller's number, the delivery area number (which differs from the Board of Trade area number), the customer's ledger number and the customer's credit rating.

The pre-billed order invoices are in sets of nine parts: (1) invoice, (2) advice note, (3) signature sheet, (4) ledger posting copy, (5) warehouse issue copy, (6) loader's copy, (7) traveller's copy, (8) open order book copy, and (9) progress copy. When the set is entered, the last three (numbers 7, 8 and 9) are removed, and number 7 is sent to the 'Powers room,' where 40-column cards are punched. One card is punched for each customer's order, and one card for each item on the invoice. When the cards have been verified the number 7 document is sent to the traveller.

From these cards a daily tabulation is made of designs within each product group and sent to the order control department, which publishes information of weekly requirements in terms of daily quotas of finished articles. Every six weeks the sales research department puts out an estimated machine order, showing the level of production expected for the next three months. This allows production control to make arrangements ahead for expected fluctuations in production capacity required, and to give warning to lay off or engage labour. At the end of each week a tabulation of this information, netted down (*ie*, making allowance for cancellations and credits), is sent to the sales research department, who assess parts requirements for future production and issue a machine order to the production control department, so that steps can be taken to ensure a supply of parts into the parts store. Thus sales are collated with production orders, and the weekly machine order, checked against the known capacity of each machine, is based on the corresponding six months of the previous year and on the weekly tabulation.

The sales research department also has a daily record of the volume of business from each source of orders—travellers, showrooms retail shops, mail order houses and individual customers. A weekly tabulation is made of the volume of sales in each Board of Trade area. Monthly tabulations are made of the volume of business from each customer and the designs bought by mail order houses.

Comprehensive sales statistics are prepared on the 40-column cards and include daily, weekly and monthly analyses by design, colour, product group, etc. All these analyses come either from the customers' cards or from the detailed invoice cards.

FOR THE FUTURE

Since February, 1959, the company has been looking into the feasibility of an integrated system employing an electronic data processing system or 'computer.' The routines being considered for integration are order entry, sales analysis, invoicing and despatch, manufacturing control to allocate assemblies in the factory, sales ledger, stock control in the warehouses, parts stores, timber stocks, payroll and cost analysis. The data processing system would be used to give the information on which the sales forecasts and production planning can be based. It would enable the company to make its sales forecasts much more quickly, and therefore, much earlier, than has hitherto, been possible.

Information could be fed into the machine by punched cards from orders received, containing the customer's number, the design number and quantity of the goods ordered. All other continuing information could be stored either in a machine's memory store or in a punched card file.

Throughout the planning phase the aim has been to evolve a fully integrated system that will eliminate the waste of time and duplication of work that may occur when data processing is passed between discrete office departments. In adopting the view that their data processing system had to be approached as a totality, Harris Lebus Ltd are in line with all progressive thought on the subject.

AMERICAN REPORT from John Diebold and Associates, New York

New Products Hit The American ADP Market

More transistorised computers appear

New transmission and data collection systems are announced

THE new generation of computers in the USA were first discussed in an 'American Report' published last year.* These computers are on the whole medium- to large-scale business data processing systems of transistorised design providing extensive time-sharing features. It is appropriate at this time to review how this generation of computers has expanded in the past year and report on the new equipments which have recently been announced and which will be available late this year or during 1961. The new equipments, for the most part, are small- to medium-scale data processing systems and small computers designed for scientific applications. In addition to the computers themselves, faster and more reliable data collection and transmission systems have been announced. This type of equipment will lend itself to the development of integrated data processing networks which collect and process data from remote points. Compatibility between the large- and small- to medium-scale computing systems also aids the utilisation of such integrated data processing systems. The small computing systems can perform the preliminary processing at remote locations and submit the summary data via the transmission systems to the central processing centre. The central processing centre can subsequently return vital data to the remote points.

TRANSISTORISED COMPUTERS DELIVERED

Both RCA and National Cash Register Company have made installations of their computer systems during the past year. There are now 15 RCA 501 systems installed and another 60 on order. There has been a tremendous amount of interest shown in this equipment. One of the recent installations was made in Wall Street where RCA are operating a service centre for investment and brokerage firms. A bank application has been in operation for several months in Philadelphia at the Fidelity Trust Company where they are processing special checking accounts initially. The Chase Manhattan Bank of New York has placed orders for two 501 systems which will be used in conjunction with magnetic ink character recognition equipment. This system is to be installed early in 1961. RCA have expanded its ADP product line recently. In April they announced two new

* *See March, 1959, issue of* AUTOMATIC DATA PROCESSING.

Name of System	IBM 1401	Honeywell 800	Univac Solid-State Computer	RPC 4000	Bendix G-20	RCA 301	
Purchase Price 4 Unit Tape System	$125,600 card system to $315,000 tape system	$390,000	$347,900 card system to $477,500 tape system	$120,000 basic	$180,000 to $435,000		
Expected Initial Deliveries in United States	Fourth Quarter, 1960	Summer, 1961	June, 1959	July, 1960	Late 1961		
Availability in United Kingdom	1961	No plans at present.	Expect to make the system available during 1961.	During 1961	Late 1961	(Plans are in the process of being formalized.)	
Internal Storage	1,400 2,000 Characters or 4,000 Core Storage	1,024 words core 2,048 storage	5000 words drum storage	72 up to 328 words of magnetic-strictive delay lines.	4,096 to 32,768 words core storage	16,000 or 20,000 characters core storage	
Auxiliary Storage	Magnetic tapes: maximum: 6 units capacity per reel: 5,760,000 to 14,000,000 char. transfer rate: 15,000 up to: 62,500 characters sec.	Magnetic tapes: maximum: 6 units capacity per reel: 20,000,000 decimal digits transfer rate: 90,000 decimal digits second	Magnetic tapes: maximum: 10 units capacity per reel: 2,400,000 characters transfer rate: 25,000 char. second	Magnetic tapes: endless loops: 250 ft. length: maximum: 15 units capacity per loop: 1,000,000 chars. Average access to a record: 0.5 to 1.5 sec.	Magnetic tapes: maximum: 70 units capacity per reel: 2,000,000 words transfer rate: 60,000 char. sec.	Magnetic tapes: maximum: 12 units capacity per reel: 3,600,000 chars. transfer rate: 7,500 char. sec.	Record File-disc storage; maximum: 5 units capacity per unit: 4,600,000 characters average access to a record: 4.25 seconds transfer rate: 2500 char. second
Input Card Reader Paper Tape R.	800 cards minute	650 cards minute Will be available.	450 cards minute	400 cards minute 60 or 500 char. sec.	800 cards minute 500 char. second	600 cards minute 100 char. sec.	
Output Card Punch Paper Punch Printer	250 cards per minute 600 lines minute print storage optional	100 or 250 cards minute Will be available 900 lines minute print storage optional	150 cards minute 600 lines minute buffered output	20 or 300 char. sec. 150, 500 or 1000 lines minute	250 cards minute 100 char. second 600 or 900 lines minute buffer units available.	100 cards minute 100 char. second 600 lines minute	

What the new systems have to offer

computers, the small- to medium-scale 301 and the large-scale 601.

National Cash have installed four systems to date with two more in the process of installation. The US Marine Corps is currently using three of these systems at various locations. S C Johnson Company of Racine, Wisconsin, is using a 304 for accounting work. Their system includes a paper tape transmission system for feeding data to the central processing centre. Another 304 system is scheduled to be installed at Macy's, one of the world's largest department stores, where it will be used for billing and other data processing applications.

IBM and Minneapolis-Honeywell have not yet made any customer installations of their systems —the IBM 7070 and the Honeywell 800; however, both of these systems are scheduled for delivery during 1960. Honeywell's first installation will be made to the Associated Hospital Service in New York in October of 1960. The system will be used for hospital insurance accounting. IBM have installed a 7070 at their offices in New York for the use of the applied programming staff for development of programming systems for the computer. Deliveries to customers are expected to commence this summer: some of the first 7070 deliveries will go to insurance companies for premium billing and to oil companies for both accounting and scientific computing. The Naval Ordnance Laboratory will use a 7070 later this year for engineering computing in support of the naval missile program.

Two of the large-scale transistorised systems being installed now are the Philco Transac S-2000 and the IBM 7090. Philco has installed three systems. Three more systems to be used for scientific and engineering calculations will go to Westinghouse and United Aircraft (two) during this year or early next. IBM have installed four 7090's at Sylvania Electric. Another system will be installed in New York for the joint use of Union Carbide and CEIR. CEIR (Corporation for Economic and Industrial Research) are basically a service bureau providing all levels of computing service. Three more 7090 systems will be used by CEIR at various locations around the country in the near future.

SYSTEMS RECENTLY ANNOUNCED

The first quarter of 1960 has seen a number of new computer systems announced, mostly in the the medium-scale range. (See Table above.) A little over a year ago, Remington Rand announced their Solid State Computer and have since installed over 50 of these systems in the USA. Recently other manufacturers have stepped in with new medium-scale equipment to compete with Remington Rand's system. One of the important features of some of the new systems is their compatibility with larger-scale systems.

There are two situations where complete compatibility between systems is very desirable. First, a company often will purchase a computer system which can handle present needs, but with an eye to the future when they will graduate to a larger-scale system. When the step is taken, and the systems are compatible, a major reprogramming and file conversion job will not be necessary. This is a very important economic factor.

The second situation where system compatibility is of major importance is where a company are using both large and small computing systems and have a need for intercommunication between the systems. Compatibility is important in both

interchange of data files, input and output and in programs.

The IBM 1401 system, announced in October of 1959, is basically an input-output conversion and editing system for large-scale computing systems. It processes magnetic tapes which can be used directly on all of IBM's magnetic tape machines from the 650 on up to the 7090. It utilises very high speed card equipment, the reader handles a maximum of 800 cards per minute, and the punch a maximum of 250 cards per minute. The 1401 can also use the high speed high density tapes used on the 7070 and other of IBM's machines. These features make the 1401 a very effective system to be used in conjunction with a large-scale system. It takes over the time consuming job of preparing input and output in the form of magnetic tapes for the more powerful systems.

The 1401 is certainly not limited to use with a large-scale system. It can also be used as a data processor in itself and will probably be utilised in remote locations for processing of data. Its output will be compatible with the system in the central data processing centre for purposes of either card-to-card or the high speed magnetic tape-to-tape data transmission. It has been reported that IBM had received over 750 orders for the 1401 in January of 1960.

Minneapolis Honeywell have just announced their Honeywell 400 system which is a medium-scale transistorised data processor, compatible with their large-scale 800 model in both programs and magnetic tapes. This system announced during March of this year is scheduled for delivery in mid-1961. It is a powerful system in terms of magnetic tape processing speeds and internal speeds and has sufficient internal core storage to handle a wide range of data processing applications. A company which instals a 400 system will be able to graduate to the large-scale 800 system with a minimum of conversion procedures.

Honeywell have stated that 'the design of the Honeywell 400 has been carefully specified to ensure an efficient correspondence between the 400 and the 800. This high efficiency of correspondence is obtained by having the two machines use a common language for both programs and data and by having them use the same magnetic tape units, the same high-speed printer and the same punched card readers and punches.'

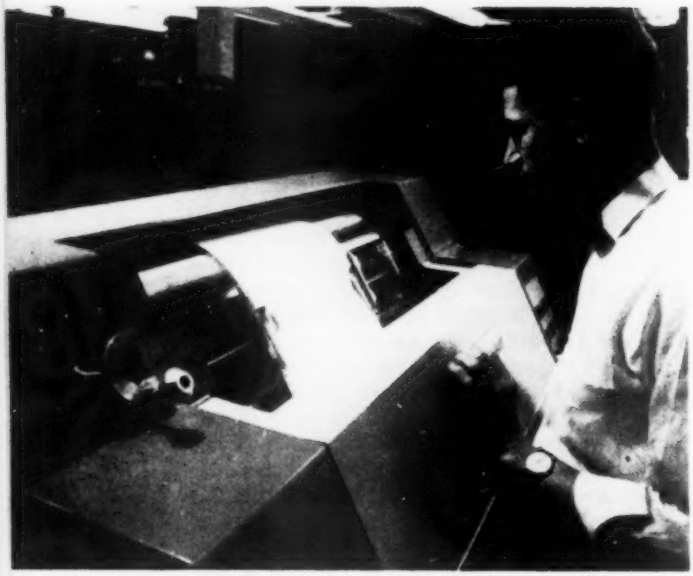
The third system announced recently in this same category is the RCA 301 system. While specifications on this equipment are not available at the date of this writing, it is expected that this system will also have the compatibility feature. It should be compatible with RCA's 501 systems now installed and their newly announced 601 system.

Two other medium-scale systems have been announced by manufacturers who have to date only had small-scale systems. These are Bendix with the G-20 system and Royal McBee with the RPC 9000. These two systems are quite different, yet it is interesting to note that two companies who had considerable success with their small-scale scientific computers have now moved into the business data processing computer market.

The Bendix G-20 is transistorised and modular in construction. Its most interesting feature is its ability to accommodate up to 70 input-output units on each of its communications lines. Any configuration of peripheral equipment, including magnetic tape, punched card, paper tape and buffer units can be attached to the communication line. Each buffer unit—a 1,024 magnetic core unit—can handle an additional communication line, thus expanding the system to an even greater size. Extensive time sharing is possible with the system. Units on the communication lines can communicate directly with each other, through the buffer unit or through the central processor. While the system could be a medium-scale system, it has the possibility to be expanded into a very complex and powerful computing device.

The RPC-9000, on the other hand, is designed as a small data processing system. Its interesting feature is its magnetic tape storage which is made up of endless loops stored in cartridges, each with a capacity of up to 1,000,000 characters. As many as eight of these loops may be searched simultaneously with a maximum of 15 loops on line at any one time. Royal McBee state that

The 1604—a large-scale system by Control Data Corporation who are newcomers to the field



Out it comes on this printer at 900 lines a minute from the Honeywell 400 system

this system provides automatic in-line record processing. Data can be accepted in random order and all affected records, stored on the magnetic tapes, are automatically updated in a single uninterrupted sequence of operations. This is possible because the tape records can be found in random order with an access time of from 0.5 to 1.5 seconds. Simultaneous searching of records reduces the total access wait time. A variety of peripheral input-output units are available with the system. These include a punched-card reader, paper-tape readers and punches and a line printer.

NEW SMALL-SCALE COMPUTERS

In addition to the medium-scale systems discussed above, there have been several recent announcements of small-scale transistorised computers designed for scientific applications. IBM announced their 1620 computer late last year and expect to deliver in late 1960. The 1620, in the $75,000 purchase price range, is a fast machine, providing 20,000 characters of magnetic core storage, paper tape input-output and a typewriter printer. IBM is offering a Fortran translator for the computer and a wide range of mathematical routines for the solution of the common functions and problems. This computer will be useful in engineering and research departments where a great deal of computation is done and where it is desirable for the engineers and researchers to program their own problems and have the flexibility of schedule and usage not always economical on large-scale systems.

Royal McBee, who have been very successful in the USA with their LGP-30 small computer, have recently brought out the RPC 400. This is similar to the LGP-30 in terms of applications, but it has considerably more capacity and speed. Thus, it may well be applied to small-scale business data processing problems. A transistorised machine, it uses an 8,008-word magnetic drum, can read punched paper tape at the rate of 500 characters per second and punches at the rate of 300 characters per second. A basic system costs approximately $90,000. The computer can handle up to 17 input-output devices or up to 60 with slight modification. Additional units will be available in the future such as line printers and magnetic tape drums for auxiliary storage. Royal McBee expect to be in a position to deliver these computers in Britain during 1961.

NEW LARGE-SCALE SYSTEMS

Recently announced large-scale systems include IBM's 7080 system, which is basically a faster and better 705 computer. It is compatible with 705 installations so that companies converting to the new transistorised system can do so without major reprogramming right away. Compared with its predecessor, the 7080 is up to ten times as fast, occupies 30 per cent less space, and needs only 50 per cent of the power and air conditioning facilities.

Other new large-scale computers are the RCA 601 announced in mid-April and the Control Data Corporation's 1604 system. CDC, a relative newcomer to the industry, have announced and installed their 1604 computer during the past year. The first system was installed at the Naval Post-Graduate School in California. Another system will go to CDC's own computing centre in Minneapolis, Minnesota.

A SATELLITE COMPUTER SYSTEM

CDC have recently announced two new products which provide a very interesting product line as a whole. Their new equipments are a small-scale satellite computer, the Model 160, and a data collection system utilising the Model 180 Data Collector. The combination of these units with the large-scale 1604 computer can provide an automatic data collection and processing system for a large production facility. It can perform applications such as production scheduling and control, inventory control, payroll, billing and other accounting functions.

In announcing the satellite computer system, CDC has stated that 'a company's accounting department, engineering department, or statistical department, for example, can each operate a 160 computer in its own centre and direct its own data processing activities. In addition, each centre

has immediate access at any time to the high speed and large computing capacity to the large-scale 1604. In fact, the 1604 has the capacity to accept data from several such 160 centres, while simultaneously processing large amounts of other data.'

The Model 180 Data Collector is a step closer to tapping data at source for automatic data processing systems. The 180 is a self-contained device, approximately the size of a typewriter which collects and records, in a form intelligible to a computer, all the necessary data for use by computers to efficiently process such items as payroll, work-in-process inventory, costs and scheduling operations. The equipment either eliminates entirely or substantially reduces the clerical labour presently required to collect and record this type of data.

COLLECTION SYSTEMS

In addition to the 180 data-collection system, two other such systems are in early application stages. The Stromberg Transacter, a most elaborate data collection system, and IBM's 357 data-collection system are both installed in aircraft plants for collecting production and labour data. The Transacter comprises a network of remote stations located at various points on the factory floor which feed data into a compiling unit. The compiler co-ordinates and receives the data from time cards, dial settings or job cards inserted at the remote stations and produces a punched paper tape for further processing in a computer system.

'Hello, stand by for data.' This IBM magnetic tape tranmission terminal (centre unit) can send or receive 150 characters of 'electronic' data by long-distance telephone lines every second

IBM's 357 data-collection system is a punched card system which operates in a similar manner to the Transacter.

DATA TRANSMISSION SYSTEMS

Recent announcements of new equipment in the field of data transmission are very promising in terms of the application of data-processing network systems. To date, most transmission systems have been fairly slow and have lacked checking facilities required for data-processing work. While the new systems will not be put into commercial use for one to two years, the announcement of their specifications and availability dates indicates that great strides have been made in the development area of this equipment.

The Bell Telephone Company has made available their 'Dataphone' system; this consists of subsets which accept digital information in any code and converts it into tones for transmission. The Dataphone concept involves high-speed data transmission over the regular exchange and toll telephone network, as well as over private telephone circuits. Since the Dataphone subsets accept electrical bits from any equipment, it leaves the manufacturers fairly free in the design of their equipment for transmission systems.

Two of the most recent announcements by manufacturers making use of this telephone service in their transmission systems are from IBM and RCA. The RCA system is called 'Daspan' (for Data Span). Daspan is a paper-tape system which can be used with the RCA 501 system or any other equipment with common codes. It comes in three types: seven- and five-channel codes systems, to be used on telephone or teletype wires, and a high-speed system, which operates at 100 characters per second on telephone lines only, using five-, six-, seven- or eight-channel coded tapes. The system includes readers, punches, typewriters for hard copy output and the transmitting device which is the direct input or output to the telephone subset.

IBM's 'Teleprocessing' systems are available for the high-speed transmission of information on punched cards at the rate of 11 cards per minute and on magnetic tape at the rate of 150 characters per second. A model 7701 magnetic tape transmission terminal transmits and receives data from magnetic tapes used on all IBM systems.

Many other systems are being developed for use with the Dataphone and other high-speed transmission services. Yet the state of this art is still in the experimental and test stages. We can expect more widespread application of this equipment in the next few years. Such equipment will make possible far-reaching integrated data processing systems.

Names and Notes by Robot

Next: The Molecule Computer

THOSE computer manufacturers who congratulated themselves on holding aloof from the computer market long enough to benefit from the arrival of the transistor may soon find they have been outflanked by another development—molecular electronics.

A recent article in the *New York Times* reported on a meeting of the Institute of Radio Engineers when one engineer reckoned that in future the 2,500 electronic components that would occupy 200 cubic inches in a conventional computer could be 'molecularised' into a solid slab four cubic inches in volume.

'Inside the slab,' the report states, 'there would be no individual components, such as resistors, capacitors, inductors, vacuum tubes or transistors. There would only be a very small number of wires. The duties of the "vitals" of any modern electronic circuit would be performed inside solid blocks of material by intricately arranged groups of molecules.'

A number of US companies have shown considerable interest in these slabs of complex circuitry referred to as Functional Electronic Blocks (FEBS) and although production of these devices for military and commercial purposes is still a few years away, samples have been produced under Air Force and Office of Naval Research contracts.

FEBS-equipped devices will have many advantages over devices containing individual components: in power requirements, for example, where a device with subminiature vacuum tubes would require an input of five watts, one with transistors would need about one watt while an FEB device would require only 60 milliwatts. They should also make for reduction in size and weight of complex equipment.

Co-operation at last!

PUNDITS have long put out the idea that one way small- to medium-size firms could benefit from developments in business data processing was through computer syndicates: two or more companies jointly hiring or buying a machine and sharing its facilities. To a limited extent this has been done in the USA (an article describing one such venture in co-operation was published in the April 1959 issue of AUTOMATIC DATA PROCESSING), and now it is to happen in Britain.

Two Scottish insurance companies—the Standard Life Assurance Company and the Scottish Widows Fund and Life Assurance Society—are to set up a subsidiary company to own and operate a Pegasus 2 computer on their joint behalf in Edinburgh.

Initially, the computer—which will cost £150,000—will be used to revalue and recost group pension schemes and for other actuarial calculations. Due to be delivered in mid-1961, the machine will have an online printer in addition to being equipped for paper tape, punch card and magnetic tape input and output.

Why Eric?

As if there were not enough names to contend with in the computer business, the LCC have elected to perpetrate yet another: ERIC (a gimmick name derived with startling ingenuity from the initials of 'electronic recording and integrating computer').

No, the LCC have not had a computer specially designed and built for their needs, but have shopped around for a computer and ended at the IBM counter.

Recently the chairman of the Council, Mr. Sydney J. Barton, formally inaugurated an IBM 650 housed in a computer 'suite' in County Hall. It is claimed to be the most comprehensive installation of its kind in local government service in Britain. The Council will pay an annual charge of £60,000, which will cover the setting up and maintaining of the equipment, training executive,

programming and operative staff, and supplying engineering staff and a consultancy service. Initial costs—for adapting rooms, air conditioning plant, electrical and engineering work—came to an additional £30,000.

Pigeon-holes for People

THE Office Management Association has brought out an enlarged and revised edition of their booklet 'Clerical Job Grading' (first published in 1954). The idea behind job grading, explained by Mr T R Thompson, of Leo Computers, who chaired the sub-committee responsible for the booklet, is not only related to what salaries office staffs should be paid, but also to ensure that those who can do responsible jobs get them, and that those who can't, get the job most suited to their capabilities.

The booklet suggests six grades of office staff—the grades are identified by brief descriptions of tasks of varying complexity—yet as people perform their jobs with varying merit there is room within grades for increases in pay, quite apart from scope to mount the promotion ladder. Hence a scheme of clerical grading could be neatly tabulated—six grades with basic rates of pay for each grade and five 'merit rates' also entailing different salaries. It is suggested that an office manager might find this of use in dealing with the promotion and salaries of his staff.

A section of the pamphlet is devoted to grading actual clerical operations including electronic data processing operations, and this should interest (or at least make curious) the data processing manager. Computer operations mostly stand quite high on the grading ladder.

Navigation on Belgian Waterways

SOME months ago a National-Elliott 802 machine was transported to Antwerp, and delivered to the Belgian Ministry of Public Works. It was ordered for the Ministry's Hydraulics Laboratories to solve problems connected with navigation conditions on the River Scheldt, the country's main waterway.

The reports that have filtered back contained much what one would have expected: it has been used for a series of scientific computations which will throw new light on the effects of tides, currents, sandbanks and other river hazards, and is doing in less than a week work which formerly kept two civil engineers busy for stretches of six months at a time, etc.

Computer work on tides and rivers is, of course, not entirely novel. Similar work has been done at two computer centres in London—in one instance in connection with the river Nile—but this is the first time a computer has been purchased exclusively for this purpose.

The Antwerp 802 is also to be used for similar purposes in connection with hydro-electric plants and dams for the Site d'Inga on the Belgian Congo.

Ordering the Means

FOLLOWING on the report that Turitz and Co, the Swedish chain and department store group, had ordered a Ferranti Orion data processing system (see 'Names and Notes,' January) comes the news that the company are now buying equipment to feed the system. They have ordered 75 adding machines with tape-punching attachments from the Addo Company of Malmö. These machines will be used to produce the input data for the stock control and purchasing routines that will eventually be run on the Orion system. Turitz propose to keep tabs on some 50,000 items, and to handle 2,500 orders and invoices on the system.

At Your Service

THIRTEEN abstracts of articles from AUTOMATIC DATA PROCESSING have been published during the past eight months (September to April) in *Data Processing Digest*, which regularly summarises the most important contributions to knowledge in the data processing field from American and British journals and books. No other journal published outside the United States has had a comparable number of articles abstracted in *Data Processing Digest*, which is published by Canning, Sisson and Associates from Los Angeles, California.

We are grateful for this honourable mention, which is an indication of the international repute that our contributors have already earned for AUTOMATIC DATA PROCESSING as an indispensable source of information for all users of computers and data processing equipment.

If you would like to have your own personal copy of AUTOMATIC DATA PROCESSING, to read at leisure or to keep for permanent reference—one that you don't have to 'tick and pass on'—you can now order it from your newsagent and have it delivered each month to your home, for only three shillings and sixpence a copy.

AUTOMATIC DATA PROCESSING is published by Business Publications Limited, Mercury House, 109-119 Waterloo Road, London SE1.

How the Shoes get to Saxone's Shops

Stephen Rose

With a central warehouse in Leeds and their head office in Kilmarnock, Scotland, Saxone have evolved an unusual 'remote' control system for their stocks. Using teleprinters, punched tape and cards equipment head office's records are now actually one step ahead of the warehouse while turn-around time has been reduced by half.

YOU remember those war films in which glamorous Wrens moved little flags around a map while the Admiral stomped up and down shouting orders? Well, that is very much how the Saxone Shoe Co Ltd at Kilmarnock, Scotland, control their new central warehouse at Leeds, some 150 miles away, and their branch stocks all over the country.

The basic idea is so simple that one wonders it has not gained wider currency: instead of having a flag to represent each ship in your navy, why not let a punched card represent each pair of shoes in your warehouse? When stock movements occur, you simply move the cards representing the particular stock items concerned to the appropriate file.

So, just as the Admiral's battle-map shows him what is happening many miles away at sea, Saxone's card file in Kilmarnock gives them an instantaneous and up-to-date picture of their complete stock situation.

Sounds too easy? Nevertheless, this system, which was designed for Saxone by management consultants Personnel Administration Ltd, is coping efficiently with a warehouse stock of about 1,750,000 pairs of shoes, representing up to 50,000 stock variations, and is coping with something like 10,000 orders a week in half the time taken previously.

This is how it operates:—

1—As soon as a batch of shoes is ordered from one of Saxone's own factories or from other sources, an 80-column punched card is made out for every single pair of shoes in that order. This is not such a big job as it sounds. A master card is hand punched for each size, fitting, colour and style in the batch, indicating how many pairs of each have been ordered. These master cards are then run through a reproducing punch, which will produce the exact number of duplicate cards to correspond with the number of pairs ordered. At the same time an end printer prints the shoes' code designation on the left-hand edge of each card, to make visual identification easier.

In this way, a complete simulation of the whole order is produced, largely automatically, in the form of punched cards.

2—Batches of these cards are placed in an 'on order' file, awaiting delivery of the goods. Buyers can get a clear picture at any time of what orders are still outstanding. For greater convenience, the original master cards from which the detail cards were punched are filed separately, so that a summary of goods on order can be tabulated whenever required without processing all the individual cards.

3—When stock is delivered to the group's central warehouse at Leeds, a 'goods received' note is (at present) posted at once to Kilmarnock. There, the information is punched on summary cards so that any subsequent tabulation of the 'on order' file will be corrected accordingly.

In future, it is hoped to mechanise this process one stage further. The 'goods received' sum-

mary cards will be hand-punched in Leeds at the warehouse, transmitted in the form of punched tape to Kilmarnock, and fed into a reproducing punch to make out a facsimile of the original card without any manual operation. The only difficulty with this procedure is the possibility of transmission errors due to faults in the telegraph line, but this will probably be overcome by duplicate transmission and comparison of the two tapes received.

4—Detail cards corresponding to the 'goods received' note are pulled from the 'on order' file and transferred to a 'warehouse stock' file. This is the heart of the system. It means that over a million and a half pairs of shoes can be 'stocked' in the space of an office. Instead of the warehouseman in Leeds having to check a branch order against physical stock on the shelves, a card clerk in Kilmarnock has the complete inventory in front of her in easily accessible form.

The warehouse stock file is kept in a series of Evertaut 'Cardmaster' units. These are designed so that each clerk has immediate access to about 60,000 cards without leaving her seat.

5—When branch orders are received, the relevant detail cards are pulled from the warehouse stock file and used to make out stock release invoice forms. Branch orders from Saxone and other shops are sent direct to head office at Kilmarnock where they are checked against availability in the warehouse stock file. Because there is only one card for each item of physical stock, there is no danger of allocating the same stock to two different orders.

The cards are then tabulated to produce a stock release/invoice/advice note automatically. The tabulator calculates extensions as it goes along. Previously, advice notes were hand-written in the warehouse and had to be extended and verified on Comptometers at head office.

While the tabulator is printing out the invoice, a summary punch makes out a card summarizing each line.

6—Invoice summary cards are run through a card-to-tape converter and transmitted to Leeds by private line. There, a receiver prints out onto a page as much of the invoice information as is needed to make up the order.

In this way, an order can be received at Kilmarnock by first post, checked against stock on hand, converted into punched tape, transmitted and printed out in clear at Leeds within one or two hours.

Everything on the stock release note is certain to be on the shelves, so that no time is wasted searching for non-existent stock. The Kilmarnock stock records are actually *more* up to date than the warehouse itself, since stock cards are pulled before any physical order picking is done.

7—After invoicing, the detail cards are placed in a 'branch stocks' file. In this way, the old problem of keeping branch stock records up to date has been neatly solved. The file is available for tabulation whenever necessary.

When sales checks come in from the branches, no further cards have to be punched for accounting and sales analyses. The corresponding detail cards are merely pulled from the branch stocks file and can be sorted and tabulated at once.

POSSIBLE DEVELOPMENTS

Saxone's new system is a great improvement over previous methods, and some cash savings will occur. However, comptometer operators, warehouse staff, etc. will eventually be replaced by punched card personnel, while the cost of three private lines linking the Leeds and Kilmarnock teleprinters must also be included in any reckoning.

However, savings were not the object of the exercise. What really matters is that order processing time has been cut from an average of six days to only three or less, while accurate information on all aspects of central and branch stocks is now swiftly obtained at head office.

Of course, the various stages of the system represent a considerable amount of work for the punched card department, and any major increase in activity by the group could seriously strain the set-up. But this does not worry the consultants who devised the system. If any major expansion occurs, the case for letting a computer take over will be extremely strong, and the job of transferring the work to an electronic installation will be relatively simple.

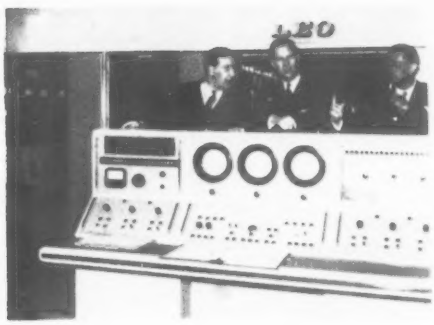
The information in three card files ('on order,' 'branch stocks' and 'warehouse stocks') could well be kept on magnetic tapes, and a computer procedure not unlike the card routine could easily be developed.

A computer could even improve on the present system. Instead of working to branch orders, as at present, a computer could well cope with a complex pattern of agreed stock levels. Thus, only sales information from the branches need be fed in. The computer could then compare this with stock availability and agreed levels and make out stock replacement orders where appropriate.

However, to work that satisfactorily, the possible delay in translating sales data into computer language must first be tackled. Consequently Saxone may soon start experimenting with a new refinement: a punched detail card to accompany each pair of shoes in its box. So each time a sale was made a punched card and not a sales docket would be returned to head office in Kilmarnock.

PLANNING AND PRACTICE—5

Which Computer?



Not all computers are equal: some are more efficient, less expensive and more useful—from *your* company's viewpoint. How to shop for the one best suited to your needs

J M Thornley

Urwick Diebold Ltd

As each new manufacturer enters the computer field and as each new computer is announced, the task of selecting the most suitable computer for a company's needs becomes more and more difficult. But at the same time the opportunities for finding the right equipment are commensurately increased.

The final basis for making a selection is usually the proposals received from equipment manufacturers, and the saying 'you cannot compare apples with pears' was never more relevant than when applied to comparing proposals from different manufacturers. There is only one satisfactory way in which proposals can be properly compared and that is to invite manufacturers to submit proposals based on the requirements of the intending user's system. The requirements should be set out clearly, explicitly and unambiguously, and they should be comprehensive.

When relations with the manufacturers are properly handled their proposals can make a valuable contribution. If not they can be quite

useless to the company seeking to choose the best equipment to meet its needs.

This article outlines a method for preparing a specification of requirements for equipment manufacturers so that they can submit proposals that are comparable one with another. It also indicates how the resulting proposals can be used as a basis for selecting a computer.

Many of the recommended steps are quite straightforward, but some require a certain amount of technical knowledge and familiarity with computers. There are three basic steps in obtaining good proposals and then evaluating them:

1. Analyse the company's data handling operations in order to specify the requirements of the data processing system. These requirements should be given to the equipment manufacturers to provide the basis for their proposals. Unless manufacturers receive explicit requirements and descriptions of data handling operations the proposals will be so different as to make comparison between them meaningless.

2. Compare the proposals developed by the various manufacturers. This involves examining the proposals critically from the viewpoint of conformity to specifications, time and cost estimates, and ability of the equipment to do the work proposed.

3. Consider the technical and hardware aspects of the proposals.

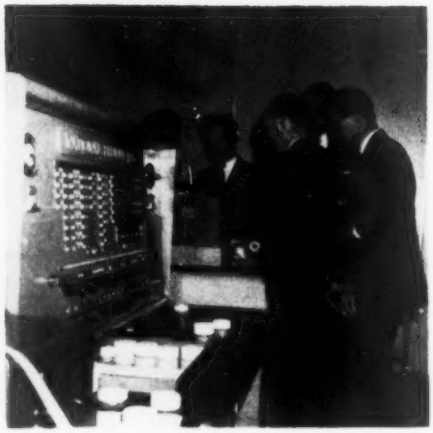
DEVELOPING SPECIFICATIONS AND ENSURING GOOD PROPOSALS

This part of the work should be done *before* the manufacturers are consulted. Its purpose should be to produce information on which the manufacturers can base their proposals. In effect this phase involves some of the basic steps of a feasibility study as described in previous articles in this series.

The nature of this work is best shown by a summary of the information that should be supplied to manufacturers.

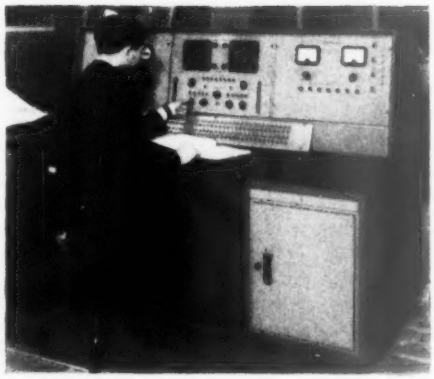
1. *Description of the Proposed System*

The proposed system will be designed from knowledge of what computers can and cannot do, but it will not be designed with any particular type of equipment in mind. The system may be shown in flow chart form with brief accompanying notes as necessary. Although integration is the ideal with any automatic data processing system no attempt should be made to design an integrated system but rather the system should be based on a number of routines, even though it is obvious that one routine can be integrated with another. Freedom should be given to each manufacturer to design the best system based on the capabilities of his equipment.



SO MANY COMPUTERS

make the task of selection



... more complex, and yet more worthwhile

2. *Requirements of the Data Processing System*

This will clearly indicate the requirements which must be fulfilled under any proposal. For example, that facilities must be provided for dealing immediately with customers' queries, or that a complete list of stock balances must be printed out each day.

These requirements should act as the basis for designing the proposed systems. Needless to say, if there are worthwhile expectations from automatic data processing, the requirements will include many things that are not at present being achieved or are just not possible with the present system.

3. *Time requirements*

There may be an overlap here with the system requirements, but it is important to indicate the time requirements that must be met (*eg.* that the pay-roll must be complete each week by 3 o'clock on Thursdays, or that sales invoices must be ready each day by 1 pm.).

The speed at which computers work should in most cases enable results to be produced earlier than with present systems. Some of the main benefits from installing a computer are to be expected from this feature.

4. *The records required to be maintained in the system*

Manufacturers will need to know the various items that make up each record (*eg.* a customer's account) and the number of alphabetic characters and digits comprising each item. No attempt should be made by the user to consolidate related records into one record and each manufacturer will then be able to bring together related records and store them in the best way that his equipment allows.

The volumes involved in each type of file will also need to be specified.

5. *Specification and volumes of each type of input*

There will be a similar requirement here as for the files of information mentioned above.

In this connection it should be remembered that input is required for three main purposes.

(a) Initial setting up of files.

(b) Daily (or weekly) processing (*eg.*, producing sales invoices).

(c) Amending the files (*eg.*, for changes to customers' names and addresses).

6. *Specification and volumes for each type of printed result*

Manufacturers should be provided with specimen forms of each type of output with typical entries

A CHECK LIST OF POINTS TO BE COVERED IN MANUFACTURERS' PROPOSALS

Manufacturers' proposals should contain the following:—

1. Procedure flow charts including both machine and manual operations.
2. Description and volumes of input, output and files for each computer run.
3. Timing estimates for each run.
4. Description of the techniques and standards used in estimating times.
5. Gantt chart schedules of all procedures in a typical month's operation of the system.
6. Equipment requirement and costs. In the case of rented equipment proposals should indicate the additional rental charges for second, third and weekend shifts. There should also be a clear definition of what a shift is—whether it is an 8-hour day, or equivalent to the user's shift, etc.
7. One-time costs such as the cost of setting up files.
8. Space and site preparation requirements.
9. Air conditioning and power requirements.
10. Description of emergency stand-by facilities that are available.
11. Personnel requirements.
12. Training facilities for programming and systems staff, operators and engineers.
13. A conversion plan including estimates of cost and timing.
14. Delivery date. If any auxiliary units such as card-to-tape converters are required earlier than the system as a whole, delivery dates should be specified. The date by which the system as a whole should be ready for acceptance by the user should also be specified.
15. Maintenance. The availability of service facilities, the cost of maintenance and the basis for charging replacement parts, etc.
16. Indication of growth potential of the specified equipment.

showing the maximum size of item in each section of the form. The frequency of issue, number of copies issued and the volumes should also be given.

7. *Expected growth in volume of the work to be handled in the system*

The growth of the business should be projected for a period of ten years, and an indication given of the probable effect on the volume of work to be handled by the new system since this will affect the size and capacity of the equipment.

8. *Desirable but non-essential requirements*

This may consist of completely new types of management control information or of more stringent requirements under 2 and 3 above. Where some of these may be met with one manufacturer's system and not with another's, they may lead to a final choice—if in other respects there is little to choose between the two proposals.

The preparation of such specifications involves a good deal of work but this is necessary if a proper comparison of equipment proposals is to be made at all. Much of this work will be necessary in any case in the systems design work that has to precede the installation of a computer.

The fact remains that considerable effort and cost are involved, and in return for it the intending user is entitled to expect worthwhile and complete proposals from manufacturers.

COMPARING PROPOSALS

The intending user should be interested in four main points in considering manufacturers' proposals.

- The end results to be obtained from the system.
- The cost of achieving the end results.
- The time taken to produce results.
- Provision for handling any expected increase in work.

If the prospective user does not provide a clear and complete specification, a hotchpotch of proposals will result and any attempt to compare one with another will be a sheer waste of time. However, each manufacturer should be free to develop his proposals in a manner that would make the best use of his particular equipment.

In reviewing the proposals the intending user needs to understand each manufacturer's system in sufficient detail to be able to make the checks listed below. Manufacturers' proposals should contain enough detail for these checks to be applied. With this in mind the task of reviewing proposals and developing the basis for a decision will involve the following steps.

1. Check that all the information called for in the specification is contained in the proposal.
2. Ensure that the proposed system meets the requirements given in the specification.
3. Make sure that the system as presented is a feasible one for producing the required information. For example, a check can be made to determine that the amount of storage is adequate for the type of records and operations proposed.
4. Check that the estimated times for producing the required results conform with the time requirements of the system.

5. Check the critical aspects of the proposals for accuracy. The main points to consider here are whether the proposed equipment is adequate and capable of doing the work in the indicated times. This will involve paying particular attention to the following questions:

(a) Is the proposed input equipment adequate to handle the requirements, especially if the input data become available irregularly in batches instead of in a smooth flow ?

(b) Has adequate peripheral equipment been proposed—tape units, off-line sort/collate equipment, etc. ?

(c) Are the computer time estimates reasonable, allowing for changing tape reels, loading the programs, unscheduled maintenance, etc. ?

(d) Do the estimated personnel requirements appear to be reasonable ?

6. Determine which clerical and other staff will be affected by each system, and the appropriate cost reductions. It will be appreciated that not all the manufacturers will suggest that the various operations be performed in the same way. Some manufacturers may, for example, recommend that certain operations be done manually or on conventional equipment.

7. Compare the various proposals by cost of installation, operating costs and savings.

8. Calculate the return on investment for each proposed system.

9. Assess the capacity available to deal with the expected increase in volume and with any other data processing applications. If the equipment proposed is such that the computer would need to be replaced (as distinct from needing to be added to) before its cost had been recovered, it would be a poor choice.

If the user contemplates converting to another type of machine when the volume of work necessitates it, the following points should be remembered.

Experience gained on one computer is of value when applied to another machine. However, programs cannot usually be transferred from one machine to another without alteration, particularly if the two machines are products of different manufacturers.

If the above procedure is followed, an orderly list of questions to be taken up with the various manufacturers can be prepared. The final comparative figures, which will be available when all questions have been answered, will enable like to be compared with like.

When the proposals have been compared and the final choice is about to be made, it is a good plan to talk with present users of the equipment most likely to be selected, to discuss their experience with the equipment and particularly in relation to scheduled and unscheduled maintenance, availability of maintenance service, actual operating speeds as opposed to speeds quoted in the proposal, and space and air conditioning requirements.

In addition to this two other factors should be considered. The first of these is the time required for delivery. Generally, this is not a very important factor. A long delivery period will mean ample time for designing the system, and this can normally be used to advantage. In certain cases however, delivery could be a deciding factor.

The second factor is concerned with reliability. Where the equipment that is likely to be chosen is already being used, a check with present users can provide valuable information. Equipment that breaks down frequently or provides incorrect answers can significantly increase the cost of operation and cancel out the hoped-for benefits.

If the final choice favours a machine that is not yet in production, the problem is much more difficult. In the case of a really new machine it is important to be sure that it will eventually materialise. The case for such a machine would have to be overwhelmingly favourable and offer very positive advantages to justify taking the risk of installing new and untried equipment.

TECHNICAL AND HARDWARE ASPECTS

It is quite possible to decide on a computer without considering the technical features of the equipment as such. They should, however, be taken into account in any critical examination of the equipment's ability to do the work intended for it.

Various selling features stressed by manufacturers will often be counterbalanced by compromises in other features of design. For example, some manufacturers will use serial rather than parallel processing to reduce hardware costs, but will sacrifice computer speed.

Again, checks on the accuracy of the internal functioning of the computer may be provided but additional circuitry will be required for this purpose. Alternatively, if programmed checks are used instead of built-in checks, less hardware will be required and costs will be lower but programming will be more complicated.

The only basis that will ensure success in the difficult task of choosing a computer is to provide selected manufacturers of equipment with a comprehensive and explicit specification of requirements.

This will require a great deal of preparatory work. However, if a computer is eventually to be installed, the work will have to be done sometime, and it is better for the intending user to do it before committing himself to equipment, than afterwards.

What Happened in 1959

John Diebold

President, John Diebold and Associates

NINETEEN FIFTY-NINE has been a good year for automatic data processing. In effect it has been a year of preparation, for most of the 'developments' that were announced, publicised, and worked on in 1959 will have their actual initiation in 1960, or even later. But that is typical of automatic data processing as well as most of today's technological developments.

Last year saw a greater increase in the number of computers than any other previous year. This increase has taken place in all sizes and types of computers. Just to give some idea of the growth and of the extent of computer usage, here are some figures from a semi-annual census of American computers in use and on order.

For large-scale systems, there are now 541 installed, a 71 percent increase over the previous year. In addition, there are over 200 of the large-scale transistorised systems on order. For medium-scale machines, the increase over a year ago is 88 percent for a total of 654 systems installed, while small-scale systems total about 2,400, a 76 percent increase.

The high 'on order' figures for all classes of machines concentrate on the new higher speed transistorised machines to an almost exclusive extent.

There are obviously other reasons for this growth than good salesmanship. The basic reasons are the same in America as in the United Kingdom and in continental Europe, although America continues to be several years ahead with respect to intensity of computer usage and applications.

It is hard to distinguish the significant US developments, but one can summarise the basis for progress of 1959 by considering four factors that have had far-reaching influence in automatic data processing.

First, development and introduction of new machines and new technical developments.

Secondly, significant developments in automatic data processing for the small- and medium-size company.

Thirdly, the growth of competition in the computer field, and fourthly, the improvement of the *use*

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First Steps to High Adventure

David Caminer

Director, Leo Computers Ltd.

THE time has come quickly in British commercial life when there are few senior executives who doubt that now, or soon, or one day, they will see an appraisal carried out of the possible impact of an electronic computer on their organisation. It might well be a prospect that they view with distaste or even dismay. But most of them cannot help feel a sense of inevitability about it all and some go so far as to mask their dismay with a boisterous expression of the high adventure of it all.

And yet one might reasonably have expected that computers would have passed from the stage of high adventure to that of something like an exact science. For though the time since the first of the computers started doing commercial work is much less than ten years, the years have been packed and so many leading organisations have taken the plunge, that the collected experience of them all should provide a very adequate store-house of experience to guide those just beginning to take the first steps in the form of appraisal on their own account. What lessons can we learn from others? What pitfalls can we recognise and avoid?

What emerges from the experience of Lyons is that it is a distinct advantage when about to make an appraisal of the possibilities of computers in one's organisation, to be already thoroughly efficiently organised in terms of existing techniques and equipment and to have a management structure such as to have available senior people able to take a forward view. So many firms, of course, are not so well poised for this further step. One is, indeed, reminded of the answer of the countryman who, when asked what was the right road to a certain village—let us call it x—replied after some hesitation: 'Well, if I were going to x I wouldn't start from here.'

Sometimes even the most case-hardened of consultants feels like that when he is making an appraisal for a client. A horror comes upon him that if the appraisal is a favourable one, the people might then act upon it and who then in the organisation will carry the project satisfactorily on its way? There is a feeling so often that before making the appraisal of the computer a great many things should have been done first. Given his choice, the consultant going toward the computer would, like the countryman, not have started from here.

However, I would not want it to be thought from this that it is necessary for a firm that has perhaps devoted less effort than it might have done in the past to the management sciences, to spend a period of years making up the lost ground before going forward to electronics. *Sometimes punched card firms will tell such an organisation that to go from its manual methods to the electronic computer in one step is too great a leap and that a steady progression from simple tabulators, to electronic*

multiplying punches, to plugboard computers and only reaching a full-scale computer when they have gained experience, is the right way to go. This is advice with which I do not agree, even though I am well aware that it is offered honestly and sincerely.

I do not agree with it because it seems to me to shirk the issue. True, it mechanises what is already being done. Indeed, the very case for this step-by-step transition is that it will cause fewer upheavals and make fewer demands on the existing management than the all in-one transition. But merely to clothe the past in a cellophane envelope will get the user nowhere. What is perfectly true is that firms starting off on their appraisal, without a developed basis in the management sciences, will need greater external assistance than one which over the years has recognised office management as a skill in its own right and has cultivated a well-rooted Organisation and Methods body.

Whatever the existing state of the organisation there is one step to be taken at an early stage. And that is to bring the top management into the picture as soon as possible. Though the proposition that the firm should make an appraisal of computers may well come from outside the board, it is a proposition that should obtain board endorsement—at least from the executive directors—as soon as possible.

It is not sufficient for the project to receive the blessing of the director particularly concerned with Finance or Administration alone. If a computer project is to be truly successful it will generally have its impact in all areas of the undertaking and the appraisal is inevitably hindered if it is not recognised by all concerned that what must necessarily be a far-reaching study is being carried out with the full knowledge, approval and support of the top management.

BLACK MAGIC BUMPS

In fact, it would not come amiss if some at least of the board were to equip themselves to receive and pass judgment on the completed appraisal. Because of the large sums of money involved the ultimate decision will almost certainly be taken by the board collectively. Yet it seems there is too great a readiness for senior people here to content themselves with a feeling that it is all black magic, and that at their age they are quite incapable of comprehending it. In Germany, France and Italy there is a much greater readiness for top management to seek a background knowledge of the subject and to spend a week or so on a course. Here, to spend a week in such a way is usually foreign to most boards. For this reason, I found it most refreshing to hear, a month or two ago, of an important and developing company starting its full-scale studies of computers by having its whole executive board attend a week's course on what makes electronic computers tick.

KEY APPOINTMENT

The most important step in a computer appraisal is appointing an executive to conduct it and submit recommendations. The extent to which the board are prepared to make sacrifices in freeing someone for this task might well be taken as a measure of the success of the venture. The person chosen should be directly responsible to a member of the board. He should be relatively young and yet be used to taking charge of projects and making recommendations.

I emphasise the appointment of a single individual for what is often thought of as a committee function.

Because it is recognised that many departments will be concerned, three or four of those most concerned are asked to second people to an appraisal committee. They sit round the table and if one with more zeal, or more interest, or more thrust establishes a pre-eminence, all to the good; otherwise, they sit in perpetual session without individual responsibilities or corporate leadership. I don't know whether committees of this sort ever existed before computers came on the scene. Certainly they make very little contribution to the progress of the art.

That does not mean that committees have no place. They do: a committee of heads of departments can consider the project as it proceeds and thus collectively help the executive responsible for study, but such a committee should be one that comes together from time to time rather than one permanently enshrined round a table. The appraisal executive should be free to choose his own assistants rather than to have to accept delegates who might well be chosen with the unworthiest of motives.

In making his appraisal, the executive will want to resolve four main points:

1. What work the computer could do in the organisation.
2. What would be the economic effect of doing that work.
3. What would be the cost of introducing a computer system.
4. If the foregoing add up to a prima facie case for going ahead, what should be the next steps.

THE WHOLE PICTURE

In assessing the work that the computer could do it is imperative that a global view is taken of the company's activities, and that the study is not departmentalised or restricted solely to the conventional clerical fields. The appraisal executive has to see the picture whole, even though he might well decide, having looked at it, that it cannot or indeed does not need to be dealt with all at once.

The appraisal then must start at the top with the productive needs of the business. It must start with results rather than with processes. Although this represents no departure from the best Organisation and Methods practise it will often come strange to

> '. . . there is too great a readiness for senior people to content themselves with a feeling that it is all black magic, and that at their age they are quite incapable of comprehending it.'

those whose experience is of the cat's-lick school. What is sought in the appraisal is a knowledge of what is wanted—wanted by *the customer*, to tell him what he had received and what he owes the company; wanted by *the supplier* to tell him what he is required to supply to where and when; wanted by *the foreman* to tell him what to make, using what machines and employing which operatives; wanted by *the factory manager* to tell him to what extent his separate processes deviated from their norms; wanted by *the employee* to tell him what he has been paid and why, wanted by the *top management* to tell them where there have been significant departures from the standards they have laid down.

To approach the requirements in this frame of mind is a novel experience to most people. It is an investigation into what is *not* being done, in the services that are *not* being satisfactorily given as well as an investigation into the best way of meeting present needs. The constant aim must be to leave behind the present system, dictated as it is by survivals of one clerical era after another.

That is one of the reasons why it is so necessary that the appraisal executive should be a person of determination and authority, articulate, and able to convince people, who have spent half their working lives making sure that some particular document was produced correctly, that really it is not needed in that form at all.

Having obtained a picture of the essential needs of the business, the appraisal executive will want to see how they fit together in an over-all picture—to see what data the computer will need and how it will be converted from the external form to the computer language, what permanent records will be wanted, what are the determinant characteristics of the picture as a whole in regard to equipment requirements and what programmes will be wanted.

It is at this stage, if not before, that the appraisal executive may well find his own background and experience inadequate. He will not, in general, have any first-hand experience of planning or programming a commercial job for actual running and he will know very little of the considerations which should be applied to the way in which jobs are organised for operation. If he is the right man he will see that he needs help and will turn for it. Where should he turn?

He can turn to the professional consultants, who more and more are offering services in computer studies, or he can turn to one or other of the computer manufacturers. But one thing he must insist upon is that whoever is delegated to give him assistance really does have the experience that he himself lacks. He must make certain that the consultant or manufacturer's planner does not merely have a command of the jargon of the trade, but really has faced the problems of getting large-scale commercial jobs running on a routine day-to-day basis. That experience is very rare indeed.

Difficult as it is to find that assistance, it must be found: otherwise the chances of the appraisal being solidly founded are remote. A little while ago a daily newspaper featured a set of headlines—*How to murder your husband. Encourage him to do it himself.* The headline is strictly opposite here. The best way to murder a computer project is to join the do-it-yourself movement. There have already been two sudden computer deaths.

COSTS AGAINST SAVINGS

We have now moved forward to the point where the appraisal team—the appraisal executive, his assistants and the expert—have roughly determined what needs to be done, what can reasonably be done by the computer, what a suitable computer installation would cost, how many shifts would be required to do the work, how many data preparation staff would be required and so on. They will also have a general picture of what systems would be employed and these will have been cleared on the way by those affected by them in an executive capacity. A picture will have been obtained of space requirements and other costs, and there will be a general idea of what clerks and other staffs should be replaced. A straightforward, if tentative, balance can be struck showing costs against tangible savings.

Another area in the study where the appraisal executive runs into difficulty is when he has found many ways in which the computer will contribute to the general efficiency of the company. He visualises, for example, that by the use of statistical techniques more accurate sales forecasts will be

made, so improving service to the customer and reducing stock holdings. How much is this kind of better service worth?

If these potential facilities were just marginal advantages the problem would not be so great, but potentially so many of them can heavily outweigh the savings to be made in terms of unproductive personnel. The happiest situation from the computer angle is, of course, the one which shows a clear profit above the line, with the comment below that there are considerable additional advantages to which it has not been found possible to put a value. But, if the balance in terms of staff and equipment savings is not so clear and a value has to be put to the intangibles, then that value must be put on them by, or thoroughly accepted by, those immediately concerned.

The appraisal executive, before submitting his report, has to consider that the mere placing of an order does not effect an immediate transformation of all his ideas into an operating organisation. Sometimes he will have been able to make out a computer case on a comparatively small series of jobs, which will be possible to bring the computer operation fairly quickly. Sometimes, however, as in some production scheduling and control applications, the whole load of the computer is represented by many jobs that will take quite a long time to prepare. He will thus be getting out a second set of costs, the costs of the detailed systems analysis, of the programming, and of the equipment and capital and staff costs during the build-up. For though a clear enough case might be made out that the system will show a profit when it is fully running, those initial costs even with the very best preparations might be quite substantial.

If the computer project over a reasonable period is showing such a substantial profit under full operation that it can absorb this early period as well as forgoing intangible advantages, the computer appraisal executive again has no problem. If it cannot, then this must necessarily be a question that is put fairly and squarely, with no disguise, in front of the board.

No appraisal is complete without recommendations as to what the next steps should be. And those recommendations cannot be confined merely to the proposal that the company buy a machine, or attempt to interest others in the vicinity in sharing a machine. It should include a statement of what jobs should be proceeded with and what personnel should be engaged. It should make clear recommendations as to whether any of the procedures should have pilot running or even full-scale running on a service basis in order to give the organisation prior experience of what is involved.

Condensed from a paper given at a BIM conference held in Glasgow in March

WHAT HAPPENED IN 1959

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made of computers through better planning and better applications.

All of these developments are interesting to us today mainly because of their influence and implications for actual business operations, and it is from this point of view that I should like to consider them today.

NEW MACHINES

The magic word in 1959 was 'transistors,' so much so that a great many things have been attributed to transistors that are not directly related to them. What the transistor means to the businessman is, in effect, a new generation of computers with new capabilities, as a result of a whole series of technological developments, some of which are completely unrelated to valve or transistor.

What does this new generation bring—something different for each company, but in general:

1. Greater reliability—machines will make even fewer mistakes (if this is conceivable) and they will be in operating condition a greater proportion of the time (which will be helpful).

2. Costs of installation will be lower, partly because of fewer environment requirements and partly because the machine systems are smaller.

3. Lower cost per unit of performance. This has several additional implications. For one thing, the greater speed of processing permits applications that were impossible before. For instance, one utility company is now able to process 100 percent of its files and records each day and thereby save a huge amount of money through eliminating controls for hold-over operations, eliminating interim files, and having all files up to date each morning. This would just not have been economically possible with the first generation of machines. Secondly, there is a tendency (and a logical one) to go from old type equipment to new, because in many cases one can do much more work for the same amount of money.

4. Greater flexibility. One machine is now able to serve many more functions than before. For instance, it is, at least from a technical viewpoint, much more reasonable to combine scientific and business applications than it was before.

If one considers the new machines that have become important factors in the market in 1959, the number is quite astounding. In the United States alone, it is tiring to go through even a partial list.

Similar technical developments have been witnessed in Britain during 1959. Ferranti announced a new computer; EMI's machines approached completion; English Electric will undertake production of the machine developed by RCA, and other

companies either have or are considering entry into the field with new developments.

All these new machines and developments may seem to bring nothing but confusion to the manager who must make decisions concerning automatic data processing in his company. In fact, they bring considerable advantages:

- a wider range of machines to choose from, each with its own particular characteristics, means that it is possible to find equipment better tailored to one's specific needs.
- the new equipment developments—through greater speed, flexibility and capacity—make it possible to come much closer to true integration.
- such concepts as immediate availability of information and immediate processing of data come closer to achievement.
- finally, what was not feasible or economical before becomes practical.

These are the points that should be of interest to the manager, for they represent the way in which he can improve direction and control.

Although the new computers announced or perfected in 1959 received most of the attention, there were other technical developments that were equally significant. In America our banking system decided on a magnetic ink character recognition and proceeded to develop applications around it, while in France, Compagnie des Machines Bull developed a new system of its own. Advances in the critical area of data communication were made through new transmission devices, while industry took a step closer to integrated data processing through improved means of gathering production data from the factory for input to the automatic system. Several new systems for automatic programming were developed and, in spite of all their sound and fury, some of the accomplishments in this field are quite promising.

SMALL BUSINESS

Directly related to technical developments and to increased competition in the computer field was an awakening of interest in the 'small company.' For several years, many small companies felt that automatic data processing was just one of the many factors making life easier for the big firm and harder for the small. Much of this was unwarranted self-pity, for service bureaux and rented time on machines have long been available.

However, 1959 saw two developments that can bring comfort to the non-giants. In the first place, computer manufacturers have begun to develop special machines. In America, the IBM 1401 is the best known example of this, a development that has been made possible only by the technical developments that are the basis for the larger machines as well. In Europe there are already other machines that are even less expensive, and no doubt this will be the forerunner of an important trend. *It is reasonable to say, now, that a firm with monthly data processing costs as low as £2,000 to £2,500 would be justified in considering a computer.* Before this was not the case.

Properly used and properly approached, these smaller machines open up whole new areas and possibilities, but they are accompanied by dangers as well. Already, many firms are ordering the smallest and cheapest on the assumption that 'they can't go wrong' by starting there. Others are finding a stronger reason (because it is cheap) to obtain a 'computer' for the sake of having one, when conventional punched cards would do as well and are cheaper. In addition, it is now easier to make a bad computer system pay. Before, to justify an expensive machine on a sound basis, it was almost essential to do a thorough, all-inclusive system design, although there are certainly enough exceptions to this statement. Today, it is even easier to avoid doing a thorough, really worthwhile job.

In addition to developing small machines, computer manufacturers in America have taken a new interest in the service bureau concept.* These new sources of computer time, called 'data centres,' are really service bureaux without the frills. The using firm does its own programming and systems work, and obtains only time from the data centre. This enables small- and medium-size firms to take advantage of the inherent superiority of the large machine.

THE WAR OF THE COMPUTERS

The third major development in 1959 was the increase in competition among equipment manufacturers. Competition is nearly always a healthy situation for the user and potential user. In the first place, there is a direct increase in the number and kind of machines available. There is also considerable pressure for the computer companies to provide ever better service, not that some have not already been doing an outstanding job in this respect for some time. The data centres that I have just mentioned are a direct outgrowth of competitive factors, as are other new ideas in the service area. For instance, one company in America has revised its rental contract to make prime shift rental pertain to any combination of 176 hours per month, rather than to eight or nine consecutive hours per day, each day. Such an arrangement, of small significance in itself and easily followed by the other companies, is indicative of the benefits of competition to computer users.

Competition will also have a direct effect on prices of computers, and this is one of the factors that can be of real interest to the businessman. In America we have had some formal announcements

* *See American Report in the January, 1960, issue of Automatic Data Processing.*

> 'There is the more basic need of finding how managements make decisions, how organisations are run, so systems designers can represent the real data needs of the company.'

of price reductions; in Europe many of the price reductions are of the more informal, bargaining kind, although they are just as real.

The speed and intensity of research is also stimulated by this new competition. Research can result in new machines, new and cheaper ways of construction, and tremendous increases in capacity and economy. It can also produce new aids in applying existing machines to business and scientific problems.

GOOD APPLICATIONS

Technical developments, new machines, and all the results of competition and new ranges of equipment are all of no avail unless they are properly applied. For a long time, it has been this area of application that cast a shadow over the data processing field. The lag between technical achievement and actual application was, say two years ago, so significant as to be almost dangerous. The lag still exists, but at least there have been worthwhile developments in the application of computers. Information instead of paper work is becoming the *raison d'être* of more and more machine systems, and the imaginative developments in 1959 have been quite interesting.

A textile manufacturer in New York uses a computer almost entirely for information on inventory, sales analysis, and materials available for sale. Not only has this been found to be profitable, but the company is developing new applications and further information requirements that will require a larger system in the next two years. A major oil manufacturer is developing a complete programme for marketing accounting that will not only reduce costs, but will provide marketing managers with up to date information on sales and sales tendencies all over the country. A drug and consumer goods manufacturer is using a computer to keep constant track of area sales in relation to a national index of purchasing power for a given area. As soon as discrepancies are detected between actual sales and sales that should be expected, corrective action is taken and the results can be measured on a week by week basis.

Another producer of consumer goods has been able to use a computer system to determine the effect of money spent for advertising and promotion, and to test the probable effect of expenditures on different types of advertising. The result has been a significant change in his advertising and promotion policy.

A chemical company is developing a programme for patent searches and classification that will save large amounts of the time of skilled research workers, while the computer is also being used to provide the company's customers with optimum mixes of fertiliser for specific conditions. A utility company will use one of the new generation of computers to overcome the problem of providing customers with up to date, accurate answers to enquiries, in addition to performing the basic data processing work. The Boeing plant in Wichita, Kansas, is using direct connections from the factory floor to the data processing centre in order to gather production data as part of an integrated system of production control.

There are many other examples: yet, although they remain the exception rather than the rule, many companies have made significant progress towards utilising some of the real potential that computers offer.

Lest all this sound like too rosy a picture, let me also sound a note of caution. Major difficulties remain to be overcome, quite apart from the technical developments that are needed (and that will come).

There is, for instance, still a very severe shortage of people qualified to develop really good automatic data processing systems. Yet, perhaps more important than training systems people is the need to educate management. Not only is there a tremendous task to be done in making management aware of what computers can do, and thus convincing them to undertake the cost and effort involved in system study and design: there is also the more basic need of finding how management makes decisions, how organisations are run, so that systems designers can have goals that represent the real data needs of the company. It is this area of management education and specialist training that remains one of the *major* obstacles to full use of automatic data processing.

Condensed from a paper given at a BIM conference held in Glasgow in March

British Electronics Industrial Council Founded

THE formation of an Electronics Industry Council was announced in London during March by the Electronics Engineering Association. Various organisations, including the Electronic Engineering Association and the Radio and Electronic Component Manufacturers' Federation, had been discussing the formation of the Council for some time.

The Electronics Industry Council will be concerned with electronic instruments, sound and television transmitters, radio communication equipment, radar and radio navigational aids, computers, industrial electronic control equipment and industrial television. It will exclude associations of manufacturers of radio and television receiving sets but its constitution 'will provide for the adherence of associations or federations of manufacturers concerned wholly or partly in the manufacture in the United Kingdom of electronic components, apparatus and equipment' for all other purposes.

The objects of the Electronics Industry Council are stated to be: 'to promote and further the well-being of the industry in the United Kingdom; to provide a channel for communication with Her Majesty's Government; and to co-operate with other industrial, commercial and mercantile bodies in the United Kingdom and abroad.'

The main function of the Council will be to deal with matters of concern to the whole industry, while its constituent bodies will remain autonomous in their own fields of activity.

The gross output of the electronics industry with which the Council will be concerned has been valued at about £200 millions annually, and it is rapidly growing. The exports from this section of the industry were worth about £50 millions in 1959 and are also increasing. One of the first tasks of the Council will be to co-ordinate statistics relevant to the industry.

Mr L T Hinton, Chairman of the Electronics Engineering Association, said in March that 'with the tremendous expansion of the industry, covering so many industrial fields, some such body as this had to be formed. The new Council, being in the capital goods field, is complementary to the Radio Industry Council, which for more than a year now has been dealing only with the associations whose members make broadcasting receivers or the components and valves for them.'

The offices of the Electronics Industry Council are at 11 Green Street, London W1.

Durban Buys a Computer

THE first computer to be installed by a City Council in South Africa has been bought by Durban City Council from International Computers and Tabulators Limited. An ICT 1202 general purpose computer was delivered to the new offices of the Durban city treasurer in Smith Street, Durban, in March. It has been estimated that the machine will save the Durban municipality at least £15,000 a year.

The city treasurer, Mr Ernest Green, and his staff have been doing preliminary programming work for the ICT 1202 since 1957. This long period of preparation has been justified by the number of functions that the machine will be able to perform. In particular, the computer will be used for the combined billing of electricity, telephone and water accounts, which will bring about an incidental saving on postage alone of £1,000 a year.

A combined payroll and leave record has been

prepared for the computer, including the preparation of paysheets, payslips, coinage specifications for cash wages, records of annual and sick leave, travel allowances and analyses of salaries and travelling costs.

Electronic Sorter Passes Trial

A NATIONAL CASH - Pitney-Bowes electronic document sorter has automatically sorted more than five million cheques at the National Newark and Essex Bank in New Jersey, USA. Not a single mistake was recorded during the period of sorting under review, the first operational use of an electronic sorter of this type to be reported.

Cheques with account numbers printed in magnetic ink were issued to a selected group of the bank's customers for the trial period. Within a year, all the cheques issued by the bank will bear the magnetic ink code, and deposit slips will later be similarly coded.

The Bank of America already has 30 Pitney-Bowes sorters in use in various branches and has a further 66 on order. Other bankers are showing lively interest in this form of automation, and it is predicted that, 'before long,' there will be more than 1,000 electronic sorters in use in American banks.

University Research by Computer

THE UNIVERSITY OF DAYTON, Ohio, is to instal a National 304 data processing system during the autumn of 1960, to be used on the university's research programme. Father Raymond A Roesch, president of the university, has announced that the machine will also be used as a service bureau for local businesses and other organisations and that the installation should be self-supporting.

The system has special facilities for handling scientific and engineering problems as well as commercial data processing. It will include 13 highspeed auxiliary units in addition to the central data processing unit.

The punched card reader will operate at a speed of 1,500 cards a minute. Seven magnetic tape units will have reading and writing speeds of 30,000 characters a second; and the highspeed printer will have a maximum output speed of 1,200 lines a minute.

Russian Scientists see Emidec

AMONG recent visitors to the Hayes plant of EMI Electronics Limited were Russian representatives from the Department of New Techniques and the Department of Peaceful Use of Atomic Energy, Moscow. They were shown several assemblies of the Emidec 1100 data processing system that are nearing completion in the factory.

Other recent visitors who have seen this new transistorised computer system have come from Japan, Germany, the United States and many other countries. The Emidec 1100 has magnetic cores as storage elements and in logical circuits. The manufacturers claim a high degree of reliability for the system, which has been selected by a number of industrial organisations and government departments in Britain.

Mechanical Engineers At Aylesford

A PARTY of delegates to the two-day conference of the Institution of Mechanical Engineers in March paid a visit to the data processing installation of the Reed Paper Group at Aylesford, Kent.

The National Elliott 405 is being employed for a variety of purposes, including a comprehensive accounting and control programme for maintenance stores. This application will be fully described in a detailed article to be published shortly in AUTOMATIC DATA PROCESSING.

Demonstrations of two applications of linear programming were given to the mechanical engineers. One programme calculated the most economical use of transport, a most important item in the operation of the Reed Group. The other concerned the minimising of trim loss during the manufacture of paper reels to customers' requirements.

Paris International Exhibition

AN international exhibition devoted to industrial measurement, control, regulating systems and automation is to be held under the title of 'Mesucora' in the Palais of the Centre National des Industries et des Techniques, Paris, from 9 to 17 May, 1961. The address of the organising secretary-general is at 20 Rue Carpeaux, Puteaux, where all enquiries about the exhibition should be sent. The organisers of the exhibition have offered a cordial invitation to British exhibitors to take part.

A GLOSSARY OF TERMS

What is a Hartree Constant? As readers will learn when we publish a comprehensive glossary of some 1,800 terms used in scientific and business automatic data processing, it is '*the latest estimate of the time which will elapse before your computer is delivered*'. We estimate it will only be a short time before the glossary is in your hands as it will be mailed with the June issue to all subscribers of AUTOMATIC DATA PROCESSING.

CONFERENCES

27-28 May
Conference on 'The Computing Laboratory in the Technical College'
Organised by Hatfield Technical College
Venue : Hatfield Technical College
Enquiries to : Head of the Mathematics Department, Hatfield, Herts.

25 June-5 July
British Conference on Automation and Computation
Organised by International Federation of Automatic Control
Venue : Moscow
Enquiries to : The Secretary, The Institution of Production Engineers, 10 Chesterfield Street, Mayfair, London, W1.

4-8 July
Second Annual Conference of the British Computer Society
Organised by British Computer Society
Venue : Harrogate
Enquiries to : Miss D E Pilling, Electronic Computing Laboratory, The University, Leeds, 2.

COURSES AND LECTURES

16 May-3 June
Course on the Emidec 2400
Organised by EMI Electronics Ltd
Fee : 50 guineas
Venue : EMI Electronics Ltd, Hayes, Middx.

17 May
Inventory Management Seminar
Organised by British Institute of Management
Venue : Birmingham
Enquiries to : The Conference Secretary, BIM, 80 Fetter Lane, London, EC4.

6 June
Computer Course on the Emidec 2400
Organised by EMI Electronics Ltd
Fee : 50 guineas
Venue : EMI Electronics Ltd, Hayes, Middx.

13-17 June
Executive Course—General Appreciation Course on Computers
Organised by Leo Computers Ltd
Fee : 25 guineas
Venue : Leo Computers Ltd, Hartree House, 151a-159a Queensway, London, W2.

13-24 June
Course on the Pegasus Computer
Organised by Ferranti Ltd
Fee : £30
Venue : Newman Street, London.
Enquiries to : Mrs J A Hickman, Ferranti Ltd, 41 Portland Place, London, W1.

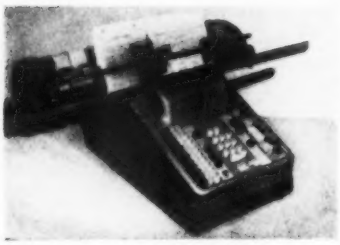
13 June-1 July
Computer Course on the Emidec 1100
Organised by EMI Electronics Ltd
Fee : 50 guineas
Venue : EMI Electronics Ltd, Hayes, Middx.

27 June-29 July
Programming Course for Leo II
Organised by Leo Computers Ltd
Fee : 110 guineas
Venue : Hartree House, 151a-159a Queensway, London, W2.

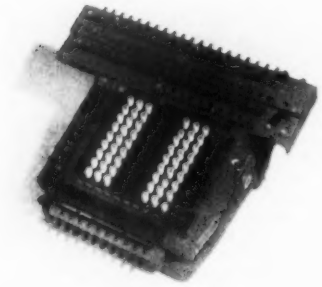
A Burroughs Typing Sensimatic for all types of accounting records ▶

What to See at THE BIRMINGHAM EXHIBITION

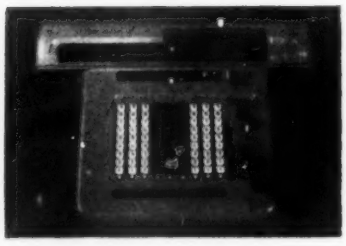
MAY 16 — 21



▲ Underwood's Postmaster 92 accounting machine



▲ Madas calculator by Muldivo



▲ Archimedes Diehl's 'dial' calculator

Previous Business Efficiency Exhibitions have always been gigantic shop windows for the office equipment industry. As such they have provided—as will the Birmingham Exhibition—executives with the opportunity to examine a wide cross-section of the products offered by an industry devoted to selling efficiency for the office.

As with other shop windows not all the displays have a novelty value: on the stands machines and systems of some vintage nudge new and improved equipment on show for the first time.

In this preview of the Birmingham BEE we have attempted to highlight equipment that will interest the executive concerned about or seized with data processing problems, with particular emphasis on methods to achieve economic mechanisation of office work, better communication of information, and better control of activities.

For greater convenience a quick guide to equipment is given under six categories.

1 Accounting, analysis, book-keeping, adding and calculating machines

A WIDE range of accounting and book-keeping machines are available to suit all sizes of organisation. Inevitably the price of these machines is directly related to the number of facilities a machine has.

Capable of producing invoices, advice notes, ledger cards, etc, these machines usually operate on the principle of making one entry on all the relevant documents simultaneously.

Increased attention is being devoted to accounting machines with tape perforating attachments which can produce punched paper tape as a by-product of normal invoicing and book-keeping procedures. Similarly, there are machines which can be linked

to card punches. The advantage of such developments is that they open up for the small- and medium-size firm the possibility of analysing orders and sales much more exhaustively: for cards and paper tape can be sent to a punched card or computer bureau for processing. Burroughs, National Cash and Remington have all adapted accounting machines to produce cards or paper tape as by-products.

For accountants and scientists continually making calculations as well as for accounts offices, a wide range of adding, adding-listing and calculating machines are available. By and large, adding and calculating machines are of two types: either they print out their results or they indicate them on dials.

Extra gadgetry is being added to these machines: adding machines are now on the market which can be linked to card punches or which have built-in tape punches, and there are also machines that can be operated automatically by paper tape.

▲ This Logabax accounting machine has 207 registers

Exhibitors whose equipment comes under this section:

ARCHIMEDES - DIEHL - MACHINE CO. LTD.
STAND 27.
Chandos House, Buckingham Gate, London, SW1.

BLOCK & ANDERSON LTD.
STAND 75.
Banda House, Cambridge Grove, Hammersmith, London, W6.

BRITISH OLIVETTI LTD.
STAND 3.
10 Berkeley Square, London, W1.

BULMER'S (CALCULATORS) LTD.
STAND 70.
47-51 Worship Street, London, EC2.

BURROUGHS ADDING MACHINE LTD.
STAND 90.
356-366 Oxford Street, London, W1.

COMPTOMETER LTD. GREAT BRITAIN.
STAND 53.
Aldwych House, Aldwych, London, WC2.

GEORGE ANSON & CO. LTD.
STAND 40.
75 Southwark Street, London, SE1.

LOGABAX LTD.
STAND 60.
21 Buckingham Palace Road, London, SW1.

LONDON OFFICE MACHINES LTD.
STAND 35.
128 Terminal House, Grosvenor Gardens, London, SW1.

MANIFOLDIA LTD.
STAND 51.
Bromford Lane, West Bromwich, Staffs.

MONROE CALCULATING MACHINE CO. LTD.
STAND 100.
Bush House, Aldwych, London, WC2.

MULDIVO CALCULATING MACHINE CO. LTD.
STAND 18.
Dorset House, Salisbury Square, London, WC2.

NATIONAL CASH REGISTER CO. LTD.
STAND 18.
2-4 Earnshaw Street, London, WC2.

OLYMPIA BUSINESS MACHINE LTD.
STAND 11.
35 Red Lion Square, London, WC1.

REMINGTON RAND LTD.
STAND 4.
Dinneford House, 12-14 Clipstone St, London, W1.

UNDERWOOD BUSINESS MACHINE LTD.
STAND 96.
4-12 New Oxford Street, London, WC1.

2 Communication Systems
Central Dictating Systems

THE logic of introducing large punched card or computer installations into commercial organisations is the centralisation of clerical functions. For this centralisation to be effective, flows of information have to be routed to the data processing centre—and this may mean, in a dispersed organisation, setting up an efficient communication system. Admittedly, in a number of cases, the postal services may well suffice, but where rapid transfers of information are required, teleprinting links—whether through the GPO's telex service or via private telephone lines—are an obvious answer.

Units that read and transmit information on punched tape have been available for some time. So have receivers that punch out paper tape. This means that the distributing depôts of, say, a tyre manufacturer could prepare the data which had to be seen by head office on paper tape—on any of a wide range of machines, which will produce this as a by-product. (Accounting machines with this facility were mentioned in section one, but there are also typewriters which can punch paper tape—some, in fact, are quite sophisticated machines such as the Flexowriter.)

At the headquarters end the receiver which will produce the transmitted data on a punched tape offers: first, a direct computer input medium; secondly, the means to obtaining the information on punched cards (by dint of using a tape-to-card converter), and lastly the means for printing out 'in clear' the information on the tapes through special electric typewriters.

A complete system for the automatic transmission of data from several points in a factory to a central point will be exhibited by Bulmers. This system—the Collectadata (which

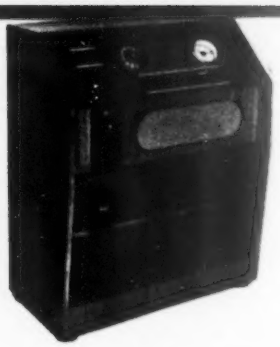
(continued on page 40)

was mentioned in our 'Accessories' columns last month) involves the use of pre-punched cards (or previously prepared edge-punched cards) which are inserted into transmitter units at various points on the shop floor to report on work-in-progress. The information on the cards is transmitted to a receiver which punches it out on an eight-channel paper tape. Thereafter the tape can be used as a computer input medium or in a tape-to-card converter.

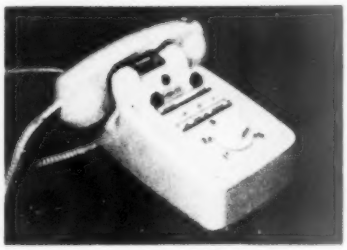
The advantages of dictating machines have long been propounded by the manufacturers of the various recording machine systems—and not without success. Central dictating systems creating 'typing pools' and a new breed of office worker—the 'audio-typist'—have come as a natural development of the dictating machine idea. Usually considered for one rôle only—that of producing a company's correspondence—central dictating systems could come to play an important part in a firm's data processing activities. For example, for order handling—as orders are received through the post, customers' names, addresses, code number—in fact, all the information that is usually put on to an invoice—can be dictated in the correct sequence. In the receiving 'pool' operators working accounting or invoicing machines 'play' the recorded orders and enter them on invoice sets. The type of equipment used in the reception area can be almost any kind of machine (suited to the company's systems): key punches for punched cards, typewriters linked to tape perforators, etc.

There are several types of central dictating systems: some make use of existing internal telephone circuits (and even the handset instrument) while it is also possible to build up a dictating complex by making use of tape, wire, belt and disc recorders—a battery of sets in the receiving pool and a machine for each executive (the tapes are routed to the pool through the internal mail).

With the advent of portable machines, it becomes feasible (though not necessarily always economic) to make salesmen record their orders away from head office and merely mail tapes to the pool.



▲ The console of Telephone Rental's new paxmaster (for private automatic phone systems)



Above: the Agavox handset for remote dictating
Below: where the message is recorded

Exhibitors whose equipment comes under this section:

AGA DICTATING MACHINE CO.
STAND 22.
St. Stephen's House,
Westminster, London, SW1.

ASSMANN DICTATING SYSTEMS LTD.
STAND 47.
27 Craven Street, London, WC2.

BULMERS BUSINESS MACHINES LTD.
STAND 78.
47 St. Worship Street,
London, EC2.

DICTAPHONE CO. LTD.
STAND 69.
17-19 Stratford Place,
London, W1.

3 Data Processing Equipment

SYSTEMS for processing data, in a generic sense, do not involve the use of any specific equipment: pen and paper, typewriters and commuters may each be the key equipment used in the clerical work of different companies. Here we are concerned with equipment which mechanises clerical work—sorting, entering, extending, storing and printing—and which impose to a certain extent methods on companies.

Punched cards have great advantages over other types of documents in that they can be sorted mechanically and used to hold data which can be added to, multiplied or printed out. Complete families of equipment to handle punched cards have long been available (and will already be familiar to readers of this magazine).

One company—ICT—will be exhibiting a range of card equipment, and also an electronic calculator. Electronic calculators are ordinarily distinguished from digital computers by the fact that they do not possess auxiliary storage capacity and operate from a fixed program of instructions. Hence, with only limited *(internal)* storage capacity, their best applications are those which require a little computation to be done at great speed in large runs.

Ferranti will be exhibiting a

SEE THE BURROUGHS **E.101 MKIII** COMPUTER FOR:

Electronic speed
Proven reliability
Maximum versatility
Unrivalled economy

THE E.101 IS THE ONLY ELECTRONIC COMPUTER WHICH COMBINES ALL THESE IMPORTANT FEATURES IN ONE MACHINE

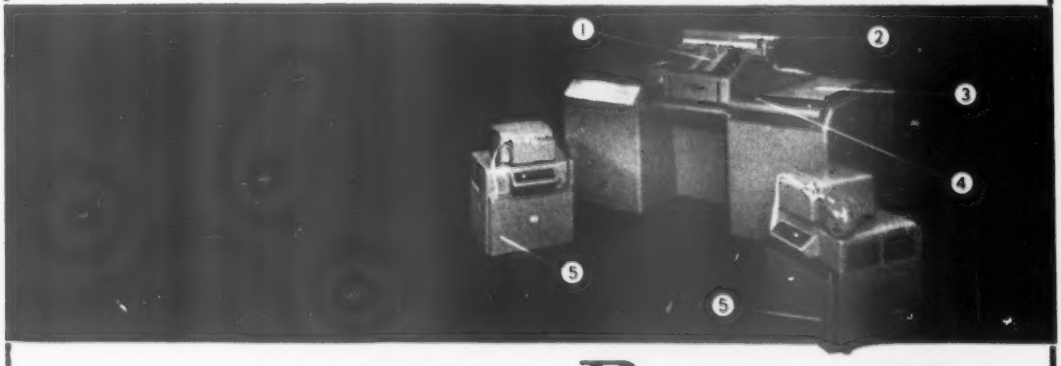
1. DIRECT KEYBOARD INPUT—
Data is entered directly into the computer, and may be printed on entry. No special preparation is necessary. This is an E.101 exclusive.

2. TABULATING PAGE PRINTER—
A highly flexible printer, incorporating an interchangeable 4-position printing and control unit, provides fast, direct printed output of intermediate and final results without using punched tape or punched cards. Another E.101 exclusive.

3. ACCESSIBLE PINBOARD PROGRAMMING—
The E.101 has a powerful and comprehensive command structure. Programs are easy to write, easy to set up, easy to record, easy to change. Every step is fully visible, and individually accessible. Auto-codes, complex plugboards, punching operations are eliminated.

4. COMPREHENSIVE OPERATOR CONTROLS—
Nine selective start-up points for automatic operation, and manual switches for the inclusion of special instructions, are designed to permit the exercise of maximum personal judgment at all stages of the operation.

5. OPERATIONAL INPUT/OUTPUT ADJUNCTS—
Three paper tape or punched card channels are available for entry of additional data, and unlimited extension of program capacity. A paper tape output unit is available to provide external memory, or link-up with other equipment.



NEW DIMENSIONS IN DATA PROCESSING BY **Burroughs**

SEE US AT THE BUSINESS EFFICIENCY EXHIBITION—BIRMINGHAM—STAND No. 90

Burroughs Adding Machine Ltd., Avon House, 356-366 Oxford Street, London, W.1. Telephone: Hyde Park 9861

small, low-priced (£17,000) computer designed for not-so-large organisations that do not have the volume of work to keep a large installation economically occupied, but who nevertheless require fast computing facilities and versatility. Suitable for carrying out statistical analyses and calculations of the type employed by design engineers and laboratory research workers, the machine can effectively handle business sales analyses and costing which can be dealt with by direct accumulation of totals in a few hundred registers.

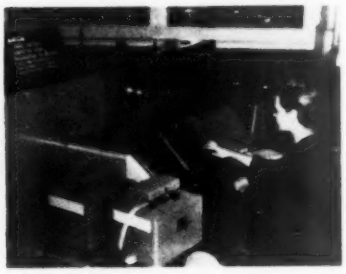
IBM's equipment for fast and random access to information will also be on show. A computer auxiliary store system it has certain advantages over present magnetic tape systems when a computer requires information in random sequence—tape systems involve serial searches through whole desks of tape which are time-wasting.

Data-flo—the Underwood complex of slave typewriters, paper tape punches and readers and calculating unit offering to the medium to small company data processing facilities presently only available to firms with large punched card installations—will be on show again.

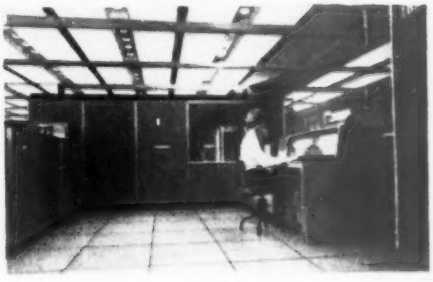
▲ Dataflo—a self-contained system of slave typewriters, punches, etc. for small-scale data processing

New equipment which again should interest the smaller company is the Addo-X machine linked to a memory drum. Basically the system enables entries to be made on a magnetic drum store through the keyboard of an electric adding or accounting machine, and also to print out through the same keyboard machine information stored on the drum. Routine jobs such as stock accounting, wage preparation and current accounting booking are the type of application suited to this linked equipment. The drum has a capacity of 10,000 words (seven decimal digits and one plus or minus sign to a word). Access time to information on the drum is 250 milliseconds and it takes two seconds to search the drum and print out one word.

▼ Ferranti's Sirius is priced at £17,000



▼ IBM will demonstrate some of Ramac's features



▲ This IBM input-output writer can be linked to a computer

Exhibitors whose equipment comes under this section:

BULMER'S BUSINESS MACHINES LTD.
STAND 78.
47-51 Worship Street, London, EC2.

BURROUGHS ADDING MACHINE LTD.
STAND 90.
356-366 Oxford Street, London, W1.

FERRANTI LTD.
STAND 74.
Hollinwood, Lancs.

IBM UNITED KINGDOM LTD.
STAND 73.
101 Wigmore Street, London, W1.

INTERNATIONAL COMPUTERS AND TABULATORS LTD.
STAND 44.
149 Park Lane, London, W1.

PUNCHED CARD ACCESSORIES LTD.
STAND 80.
Abbey House, Victoria Street, London, SW1.

UNDERWOOD BUSINESS MACHINES LTD.
STAND 96.
4-12 New Oxford Street, London, WC1.

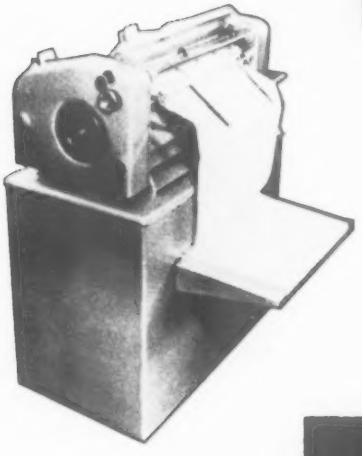
4 Control Devices

RUNNING punched card installations and computer departments efficiently, so that reports, payroll notices and invoices all come through when they are needed, become increasingly important when a large number of routines are run on the equipment. Hence, for the tab or computer room, charts become indispensable for scheduling work.

A variety of simple and elabor-

Continued on page 44

SPEEDIER SEPARATION



OF CONTINUOUS FORMS

* *Suitable for Tabulator, Teleprinter, and all Marginal Punched Continuous Stationery Systems.*
* *Guillotines either continuous single part forms or multiple sets at 6,000 forms per hour irrespective of depth.*
* *Will accept forms up to 18" wide, and from 3" to 17" deep in ½" gradations.*
* *Marginal hole punching can also be trimmed off, or the forms may be slit vertically if so desired.*

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SPECIALISTS IN CONTINUOUS STATIONERY AND BUSINESS FORM SYSTEMS

COMPUTER AND TABULATOR USERS!

When Accountant meets Accountant
Over lunch, or while commuting,
The conversation's usually
Of Punched Cards and Computing!
And each will tell the other—
" International experts say :
'When it comes to Storage Problems,
Go and talk to PCA!' "

STAND No. 80
BUSINESS EFFICIENCY EXHIBITION
BIRMINGHAM. 16th to 21st MAY, 1960

PCA 3-compartment DoorAway Cabinet with Fixed and Transportable PlastiRack Tape Reel Units. A model is available for every type and size of Tape Reel, and for Programme Boards.

PUNCHED CARD ACCESSORIES LIMITED

Abbey House, Victoria Street, London, S.W.1. **Telephone Numbers: ABBey 1396 and 2691/3**

ate charting systems are available on the market, which make use of coloured counters, pegs, adhesive strips, etc. Each installation will have its own scheduling problems, and so no one system can be said to be preferable: a careful study of the type and amount of information that needs to be displayed must precede any choice in favour of one system.

Exhibitors whose equipment comes under this section:

ADAPTA CHARTS LTD.
STAND 58.
129 Hammersmith Road,
London, W14.

ARCHIMEDES - DIEHL - MACHINE CO LTD.
STAND 27.
Chandos House,
Buckingham Gate, London, SW1.

BLOCK & ANDERSON LTD.
STAND 75.
Banda House, Cambridge Grove,
Hammersmith, London, W6.

CARTER PARRATT LTD.
STAND 88.
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5 Reproduction Equipment

ORGANISATION and methods departments, programmers and data processing managers increasingly find a need to duplicate documents: flow charts, programming manuals and completed programs, and also in some cases the results that are printed out from computer and tabulator runs.

Currently—and this will be particularly obvious at the Birmingham Exhibition—a large number of firms offer a wide range of equipment for reproducing documents. This equipment falls into three categories which define the needs people have for reproducing documents.

First, small-scale reproduction: a small number of copies of a complete program or an 'exception report' might be needed, and this might be done on machines that dispense with intermediate 'masters' such as transfers, dyeline, heat transfer and photographic copiers. These make quick facsimile reproductions of almost any kind of original, and as a general rule the faster they perform and the better they imprint the more expensive they become.

Secondly, where several hundred, or even thousand, copies of a document are required, this is best done by one of the duplicating methods—offset litho, stencil or spirit. Electronic machines are available for cutting stencils automatically.

Thirdly, microfilm reproduction: this has the advantage that a microfilm document takes little space to store and yet is also an intermediary in high-speed reproduction processes. Hence, original documents may be dispensed with, while copies of the original are readily obtained.

▲ Produces stencils electronically the Gestefac Stencil Scanner

▲ Small document reproducer by Shannon

▼ Ditto's hand operated table duplicator

◀ Verifax copier for quick reproduction

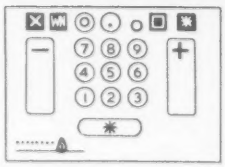
A Gestetner duplicator ▶ for long runs

Exhibitors whose equipment comes under this section are listed overleaf

new **ADDO-X** digital printer with floating decimal point

The new Addo-X 347E (S) digital printer is specially designed to print out from digital volt meters, ohm meters and other equipment giving automatic range setting—and thus requiring the print-out of *a variable decimal point*. It can also be supplied with half the capacity decimal and half special, to enable a small calculating register to be used.

These modifications can also be applied to most Addo-X add/listing, shuttle carriage and accounting machines . . . a range which covers innumerable applications in this sphere of Automatic Data Recording.



For full details, or specialist advice and consultation, please write to: Bulmers (Calculators) Ltd., ADDO-X Automatic Data Processing Division, Empire House, St. Martins-le-Grand, London EC1. MONarch 7991.

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Stand 864 Instruments, Electronics and Automation Exhibition, Olympia.

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6 Storage and Filing Equipment

IMPORTANT for many punched card equipment users is the way in which cards—perhaps a 'library' of cards—are stored. A manager of a punched card installation will be concerned with three things when looking into ways of filing cards: physical accessibility, clear visibility and economy of space. Among the numerous types of cabinets, wall units, trays and other fittings available to him he will obviously have to shop in terms of his own office layout, and with this in mind should be able to examine critically some of the storing ideas on show—such as card wheels, cabinets, desks and trolleys.

A good deal of equipment is also available for the tidy storing of other accessories found in data processing departments: racked cupboards for plugboards, racks and cupboards for magnetic tape spools, and equipment to house reels of paper tape, etc.

▲ This electric 'Cyclocard'—by Carter-Parratt—holds 36,000 cards

▼ Lateral Filing—by Ofrex—gives quick access to documents

◀ A two-tier cabinet with 14 vertical trays each for storing punched cards—by Punched Card Accessories

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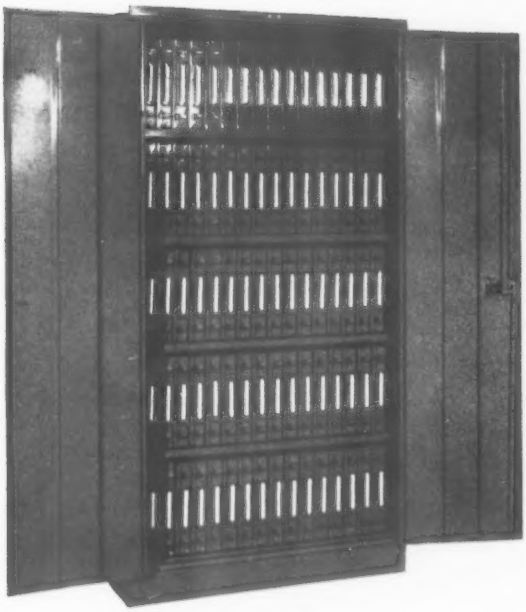

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Cabinet to accommodate 80 Spool Cases.

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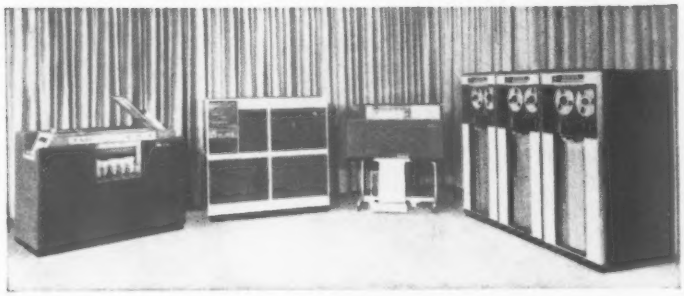
success story



Seven months ago we announced an entirely new small computer with very fast input and output—the IBM 1401 Data Processing System. We were certain that many commercial organisations needed a machine that would bridge the gap between the normal punched card system and the large-scale computer. And we were right. To date over 40 machines (about half of them with magnetic tape units) have been ordered in the United Kingdom. The first will be installed in 1961.

who is buying the IBM 1401 ?

Orders have been received from the following:—

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- Manchester Regional Hospital Board
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- The Herbert Morris Group
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- The Royal London Mutual Insurance Society Limited
- Shell International Petroleum Company Limited
- Wesleyan and General Assurance Society
- United Kingdom Atomic Energy Authority

et al.

- *With magnetic tape units*

what jobs will they do ?

Here are some of the jobs these IBM 1401 machines will be doing:

Payroll
Stock control
Sales ledger and statements
Invoicing
Statistics
Credit accounting
Production planning
Costing
Insurance—premium accounting and policy recording
Hire purchase accounting
Banking—current accounts
Nuclear research

The IBM 1401 Data Processing System in brief The basic 1401 system consists of just three units which offer

- **card reading at up to 800 cards a minute**
- **card punching at up to 250 cards a minute**
- **line printing at up to 600 lines a minute**
- **advanced stored-program calculating and control.**

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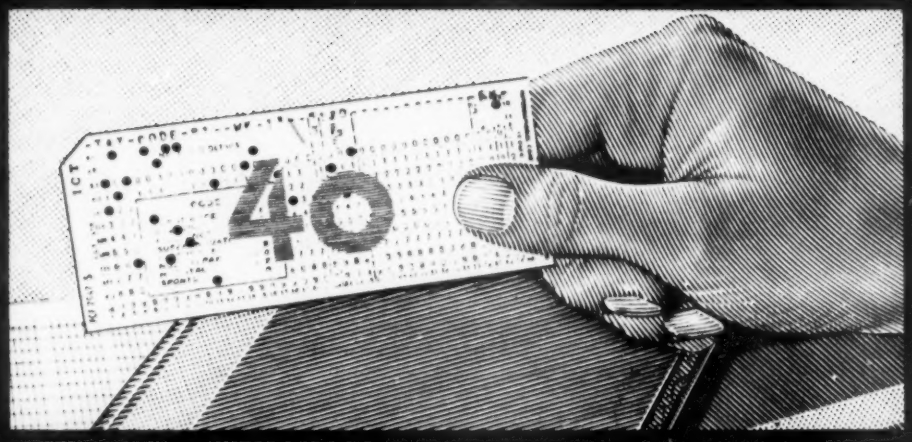

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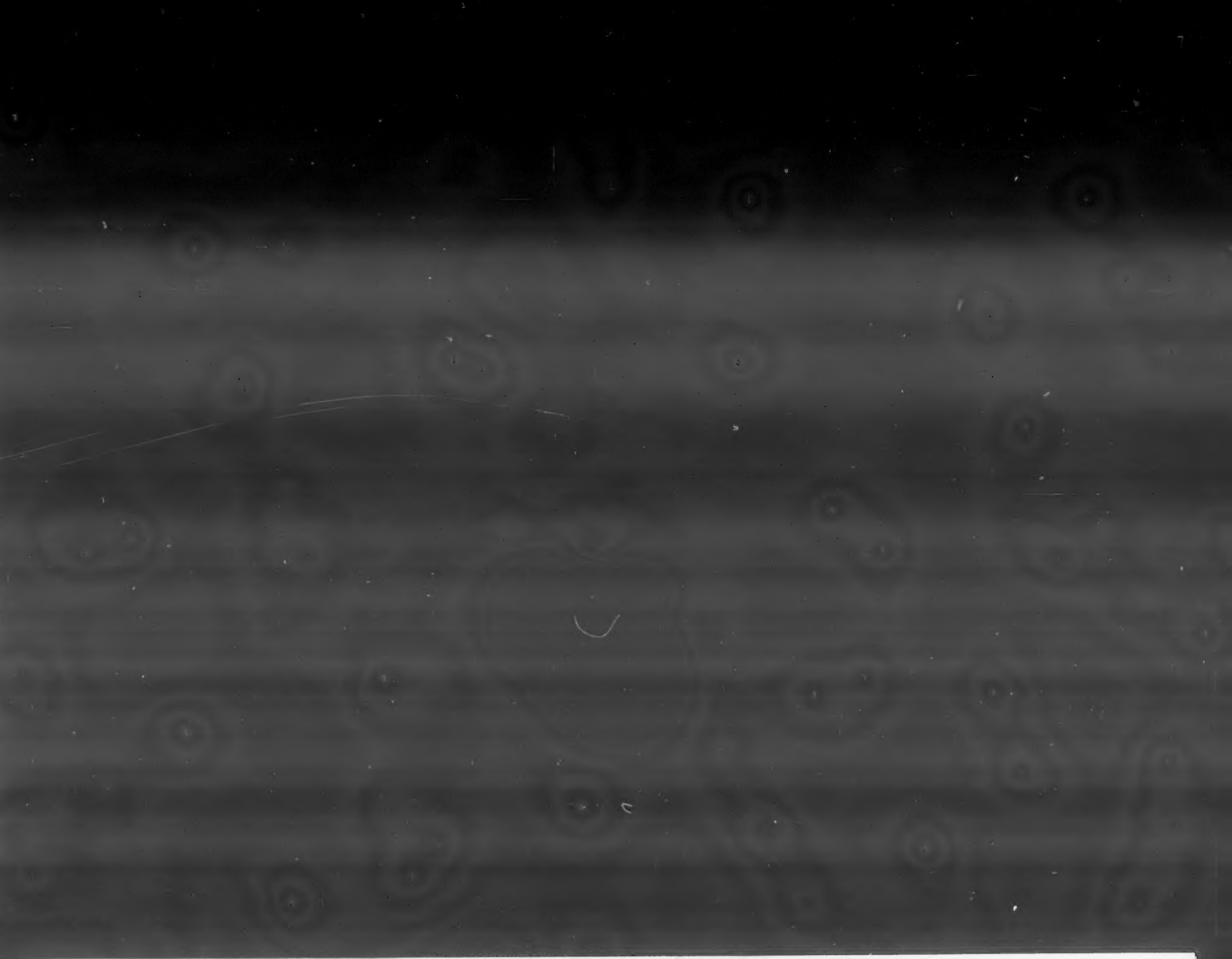
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